Heart Disease and Stroke Statistics—2008 Update

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

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Summary

Each year the American Heart Association, in conjunction with the Centers for Disease Control and Prevention, the National Institutes of Health, and other government agencies, brings together the most up-to-date statistics on heart disease, stroke, and their risk factors and presents them in its Heart Disease and Stroke Statistical Update. The Statistical Update is a valuable resource for researchers, clinicians, healthcare policy makers, media, the lay public, and many others who seek the best national data available on disease and risk factor prevalence, disease incidence, and mortality rates in a single document. This year's edition includes several areas not covered in previous editions. Below are a few highlights from this year's Update in the areas of cardiovascular disease (CVD) mortality, control of risk factors, kidney disease, and medical care.

Death rates from CVD have declined, yet the burden of disease remains high.

- The 2004 overall death rate from CVD (*International Classification of Diseases 10*, I00–I99) was 288.0 per 100 000. The rates were 335.1 per 100 000 for white males, 454.0 per 100 000 for black males, 238.0 per 100 000 for white females, and 333.6 per 100 000 for black females. From 1994 to 2004, death rates from CVD (*International Classification of Diseases* 10, I00–I99) declined 24.7%. Preliminary mortality data from 2005 show that CVD (I00–I99; Q20–Q28) accounted for 35.2% (861 826) of all 2 447 910 deaths in 2005, or 1 of every 2.8 deaths in the United States.
- Nearly 2400 Americans die of CVD each day—an average of 1 death every 37 seconds. The 2005 overall preliminary death rate from CVD was 279.2. More than 148 000 Americans killed by CVD (I00–I99) in 2004 were <65 years of age. In 2004, 32% of deaths from CVD occurred before the age of 75 years, which is well before the average life expectancy of 77.9 years.
- Coronary heart disease caused 1 of every 5 deaths in the United States in 2004. Coronary heart disease mortality was 451 326. In 2008, an estimated 770 000 Americans will have a new coronary attack, and about 430 000 will have a recurrent attack. It is estimated that an additional 175 000 silent first myocardial infarctions occur each year. About every 26 seconds, an American will have a coronary event, and about every minute someone will die from one.
- Each year, about 780 000 people experience a new or recurrent stroke. About 600 000 of these are first attacks, and 180 000 are recurrent attacks. Preliminary data from 2005 indicate that stroke accounted for about 1 of every 17 deaths in the United States. On average, every 40 seconds someone in the United States has a stroke. From 1994 to 2004, the stroke death rate fell 24.2%, and the actual number of stroke deaths declined 6.8%.
- In 2004, 1 in 8 death certificates (284 365 deaths) in the United States mentions heart failure.

Control of risk factors remains an issue for many Americans.

- The age-adjusted prevalence of high low-density lipoprotein cholesterol in US adults was 26.6% in 1988–1994 and 25.3% in 1999–2004. Between 1988–1994 and 1999–2004, awareness increased from 39.2% to 63.0%, and use of pharmacological lipid-lowering treatment increased from 11.7% to 40.8%. Low-density lipoprotein cholesterol control increased from 4.0% to 25.1% among those with high low-density lipoprotein cholesterol.
- Overall, 62.0% of adults ≥18 years of age engaged in at least some vigorous and/or light-moderate leisure-time physical activity lasting ≥10 minutes per session. In 2002–2004, 40.2% of people ≥75 years of age (age adjusted) engaged in at least some regular leisure-time physical activity. Men were more likely (64.0%) to exercise than were women (60.2%).
- More than 9 million children and adolescents between 6 and 19 years of age are considered overweight on the basis of being in the 95th percentile or higher of body mass index values in the 2000 Centers for Disease Control and Prevention growth chart.
- On the basis of data from the National Health and Nutrition Examination Survey, the prevalence of overweight in children between 6 and 11 years of age increased from 4.0% in 1971–1974 to 17.5% in 2001–2004. The prevalence of overweight in adolescents between 12 and 19 years of age increased from 6.1% to 17.0%. In 2003–2004, 36% of women 65 to 74 years of age and 24% of women ≥75 years of age were obese. This is an increase from 1988–1994, when 27% of women 65 to 74 years of age and 19% of women ≥75 years of age were obese. For men, from 1988–1994, 24% of those 65 to 74 years of age and 13% of those ≥75 years of age were obese, compared with 33% of those 65 to 74 years of age and 23% of those ≥75 years of age in 2003–2004.
- One and a half million new cases of diabetes were diagnosed in people ≥20 years of age in 2005.

The 2008 Update expands data coverage of CVD-related kidney disease.

- End-stage renal disease and chronic kidney disease are conditions that are most commonly associated with diabetes and/or high blood pressure and occur when the kidneys can no longer function normally on their own.
- The incidence of reported end-stage renal disease has almost doubled in the past 10 years. In 2004, 104 364 new cases of end-stage renal disease were reported.
- The number of persons treated for end-stage renal disease increased from 68 757 in 1994 to 102 356 in 2004; this translates to 261.3 per million in 1994 to 348.6 per million in 2004.
- The US Renal Data System estimates that by 2010, 650 000 Americans will require treatment for kidney failure, which represents a 60% increase over the number who received such treatment in 2001.
- The prevalence of chronic kidney disease (stages I–V) is 16.8%. This represents an increase over the 14.5% preva-

lence estimate from the National Health and Nutrition Examination Survey 1988–1994.

- The prevalence of chronic kidney disease was greater among those with diabetes (40.2%), hypertension (24.6%), and CVD (28.2%) than among those without these chronic conditions.

Improvements in medical care are being made.

- Over a 3-year period from 2002 through 2004, among 159 168 patients admitted with heart failure at 285 hospitals, inotrope use decreased, and improvements were made in providing discharge instructions, smoking counseling, left ventricular assessment, and β-blocker prescription.
- During this same period of time, clinical outcomes improved, including the need for mechanical ventilation (5.3% to 3.4%), length of stay (mean, 6.3 days to 5.5 days), and in-hospital death rate (4.5% to 3.2%).

The American Heart Association, through its Statistics Committee, continuously monitors and evaluates sources of data on heart disease and stroke in the United States to provide the most current data available in the Statistics Update. The 2005 preliminary mortality data have been released, and although not included in this year's Update, more information can be found at the National Center for Health Statistics Web site, http://www.cdc.gov/nchs/products/pubs/pubd/hestats/prelimdeaths05/prelimdeaths05.htm.

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:

Behavioral Risk Factor Surveillance Survey (BRFSS)—ongoing telephone health survey system

Greater Cincinnati/Northern Kentucky Stroke Study (GCNKSS)—stroke incidence rates and outcome within a biracial population

Medical Expenditure Panel Survey (MEPS)—data on specific health services that Americans use, how frequently they use them, the cost of these services, and how they are paid for

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

Abbreviations Used in Chapter 1

AHA	American Heart Association
AHRQ	Agency for Health Research and Quality
AP	angina pectoris
ARIC	Atherosclerosis Risk in Communities study
BP	blood pressure
BRFSS	Behavioral Risk Factor Surveillance System
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
MEPS	Medical Expenditure Panel Survey
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
NIS	National Inpatient Sample
NNHS	National Nursing Home Survey
WHO	World Health Organization
YRBS	Youth Risk Behavior Surveillance

National Hospital Discharge Survey (NHDS)—hospital inpatient discharges (discharged alive, dead, or status unknown)

National Ambulatory Medical Care Survey (NAMCS)—physician office visits

National Hospital Ambulatory Medical Care Survey (NHAMCS)—hospital outpatient and emergency department visits

National Inpatient Sample (NIS) of the Agency for Health Research and Quality—hospital inpatient discharges and charges

National Institute of Neurological Disorders and Stroke (NINDS)—brain and nervous system disorders

National Nursing Home Survey (NNHS)—nursing home visits

National Vital Statistics—national and state mortality data

World Health Organization (WHO)—country mortality

Youth Risk Behavior Surveillance (YRBS)—trends for 6 categories of priority health-risk behaviors in youth and young adults

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 in order to provide a more realistic estimate of burden. Most estimates based on NHANES prevalence rates use data collected from 1999 to 2004 (in most cases, these are the latest published figures). These are applied to census population estimates for 2005. 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 prevalence rates estimated from surveys conducted in different years.

Risk Factor Prevalence

The NHANES 1999–2004 data are used in this 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. The unit of time is not necessarily 1 year, although we often discuss incidence in terms of 1 year. 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 editions of the Heart and Stroke Statistical Update (renamed the 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 is the number of death certificates in 2004 that mention the given disease classification either as the underlying cause or as a contributing cause. These were final 2004 data unless otherwise indicated. 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, regardless of whether it is the underlying cause or a contributing cause—ie, its "total mentions." In all comparisons of deaths and death rates between 1994 and 2004, 1994 data were modified using appropriate comparability ratios.

The first text section for each disease listed in this Update mentions mortality information. This includes the number of deaths for which the disease is the underlying cause; this is referred to as "mortality." That number is followed by "total-mention mortality." All other numbers or rates of deaths in the Update refer to the given disease as the underlying cause. The one exception, heart failure, is explained in that section.

National and state mortality data presented according to the underlying cause of death are computed from the Data Warehouse mortality tables of the NCHS Web site or the compressed CDC file. Total-mention numbers of deaths are tabulated from the electronic mortality files of the NCHS Web site.

Population Estimates

In this publication, we have used national population estimates from the US Census Bureau for 2005 in the computation of morbidity data. Data for 2004 are used in the computation of death rates. The Census Bureau Web site contains these data as well as information on the file layout.[1]

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 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.[2] Effective with mortality data for 1999, we are using the 10th revision (ICD-10). It will be a few more years before the 10th revision is used for hospital discharge data, which are based on the International Classification of Diseases, Clinical Modification, Ninth Revision (ICD-9-CM).[3]

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.[4] International mortality data are age adjusted to the European standard.[5] Unless otherwise stated, all death rates in this publication are age adjusted and are per 100 000 population.

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 2005 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. 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 2005 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 2005, 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 2005, 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 2008.

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*.

See the Glossary for an explanation of terms.

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4. Anderson RN, Rosenberg HM. Age standardization of death rates: implementation of the year 2000 standard. *Natl Vital Stat Rep*. 1998;47:1–16, 20.
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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 through 2-3 and Charts 2-1 through 2-20.

Prevalence

An estimated 80 700 000 American adults (1 in 3) have 1 or more types of CVD. Of these, 38 200 000 are estimated to be ≥60 years of age (extrapolated to 2005 from NCHS NHANES 1999–2004 data). (Total CVD includes diseases listed in the bullet points below except for congenital CVD.) Because of overlap, it is not possible to add these conditions to arrive at a total.

Abbreviations Used in Chapter 2

AIDS	acquired immune deficiency syndrome
AP	angina pectoris
ARIC	Atherosclerosis Risk in Communities study
BMI	body mass index
BP	blood pressure
BRFSS	Behavioral Risk Factor Surveillance System
CABG	cardiac revascularization (coronary artery bypass graft)
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CHF	congestive heart failure
CLRD	chronic lower respiratory disease
CVD	cardiovascular disease
ED	emergency department
EMS	emergency medical services
FHS	Framingham Heart Study
HBP	high blood pressure
HD	heart disease
HF	heart failure
HIV	human immunodeficiency virus
ICD	International Classification of Diseases
kg/m^2	kilograms per square meter
MEPS	Medical Expenditure Panel Survey
MI	myocardial infarction
mg/dL	milligrams per deciliter
mm Hg	millimeter of mercury
MRFIT	Multiple Risk Factor Intervention Trial
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
NHES	National Health Examination Survey
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung, and Blood Institute
NNHS	National Nursing Home Survey
PA	physical activity
PTCA	percutaneous transluminal coronary angiography, now known as PCI (percutaneous coronary intervention)

- High blood pressure (HBP)—73 000 000. (Defined as systolic pressure ≥140 mm Hg and/or diastolic pressure ≥90 mm Hg, taking antihypertensive medication, or being told at least twice by a physician or other health professional that one has HBP.)
- Coronary heart disease (CHD)—16 000 000.
  - — Myocardial infarction (MI) (heart attack)—8 100 000.
  - — Angina pectoris (AP) (chest pain)—9 100 000.
- Heart failure (HF)—5 300 000.
- Stroke—5 800 000.
- Congenital cardiovascular defects—650 000 to 1 300 000 (see Chapter 6).

The following prevalence estimates are for people ≥18 years of age from NHIS, NCHS 2005.[1] Note: Hypertension estimates reflect only those aware that they have hypertension.)

- — Among whites only, 12.0% have heart disease (HD), 6.6% have CHD, 21.0% have hypertension, and 2.3% have had a stroke.
- — Among blacks or African Americans, 10.2% have HD, 6.2% have CHD, 31.2% have hypertension, and 3.4% have had a stroke.
- — Among Hispanics or Latinos, 8.3% have HD, 5.9% have CHD, 20.3% have hypertension, and 2.2% have had a stroke.
- — Among Asians, 6.7% have HD, 3.8% have CHD, 19.4% have hypertension, and 2.0% have had a stroke.
- — Among Native Hawaiians or other Pacific Islanders, 22.4% have hypertension. (Other racial prevalence estimates are considered unreliable.)
- — Among American Indians or Alaska Natives, 13.0% have HD,* 2.5% have CHD, 25.5% have hypertension,* and 5.8% have had a stroke.

Incidence

- On the basis of the NHLBI's Framingham Heart Study (FHS) original and offspring cohort data from 1980 to 2003[2]:
  - — The average annual rates of first cardiovascular events rise from 3 per 1000 men at 35 to 44 years of age to 74 per 1000 men at 85 to 94 years of age. For women, comparable rates occur 10 years later in life. The gap narrows with advancing age.
  - — Before 75 years of age, a higher proportion of CVD events due to CHD occur in men than in women, and a higher proportion of events due to stroke occur in women than in men.
- Among American Indian men 45 to 74 years of age, the incidence of CVD ranges from 15 to 28 per 1000 population. Among women, it ranges from 9 to 15 per 1000.[3]
- 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 40 years of age (personal communication, Donald Lloyd-Jones, MD, Northwestern University, Chicago, Ill).

*Estimates should be used with caution.

Mortality

ICD-10 I00–I99, Q20–Q28 for CVD (CVD mortality includes congenital cardiovascular defects); C00–C97 for cancer; C33–C34 for lung cancer; C50 for breast cancer; J40–J47 for chronic lower respiratory disease (CLRD); G30 for Alzheimer's disease; E10–E14 for diabetes; and V01–X59, Y85–Y86 for accidents.

- Mortality data show that CVD (I00–I99, Q20–Q28) as the underlying cause of death (includes congenital cardiovascular defects) accounted for 36.3% (869 724) of all 2 397 615 deaths in 2004, or 1 of every 2.8 deaths in the United States. CVD total mentions (1 357 000 deaths in 2004) constituted approximately 57% of all deaths that year.[4]
- In every year since 1900 except 1918, CVD accounted for more deaths than any other major cause of death in the United States.[5,6]
- Nearly 2400 Americans die of CVD each day, an average of 1 death every 37 seconds. CVD claims approximately as many lives each year as cancer, CLRD, accidents, and diabetes mellitus combined.[4]
- The 2004 overall death rate due to CVD (I00–I99) was 288.0. The rates were 335.1 for white males, 454.0 for black males, 238.0 for white females, and 333.6 for black females. From 1994 to 2004, death rates due to CVD (ICD-10 I00–I99) declined 24.7%. In the same 10-year period, actual CVD deaths declined 8%.[4]
- Among other causes of death in 2004, cancer caused 553 888 deaths; accidents, 112 012; Alzheimer's disease, 65 965; and HIV (human immunodeficiency virus)/AIDS (acquired immune deficiency syndrome), 13 063.[4]
- The 2004 CVD (I00–I99) death rates were 341.7 for males and 245.3 for females. Death rates for cancer (malignant neoplasms) were 227.7 for males and 157.4 for females. Breast cancer claimed the lives of 40 954 females in 2004; lung cancer claimed 68 461. Death rates for females were 24.4 for breast cancer and 41.6 for lung cancer. One in 30 female deaths was of breast cancer, whereas 1 in 6 was of CHD. For comparison, 1 in 4.6 females died of cancer, whereas 1 in 2.6 died of CVD. On the basis of 2004 mortality data, CVD caused approximately 1 death per minute among females, or approximately 460 000 female lives in 2004. That represents more female lives than were claimed by cancer, CLRD, Alzheimer's disease, accidents, and diabetes mellitus combined.[4]
- More than 148 000 Americans killed by CVD (I00–I99) in 2004 were <65 years of age. In 2004, 32% of deaths due to CVD occurred before the age of 75 years, which is well before the average life expectancy of 77.9 years.[4]
- In 2004, death rates for diseases of the heart in American Indians or Alaska Natives were 182.7 for males and 119.9 for females; for Asians or Pacific Islanders, they were 146.5 for males and 96.1 for females; for Hispanics or Latinos, they were 193.9 for males and 130.0 for females.[7]
- 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 of major CVD (I00–I78) is 47%, and the chance of dying of cancer is 22%. Additional probabilities are 3% for accidents, 2% for diabetes mellitus, and 0.7% for HIV.[8]
- In 2004, the leading causes of death in women ≥65 years of age were diseases of the heart (1), cancer (2), and stroke (3). In older men, they were diseases of the heart (1), cancer (2), CLRD (3), and stroke (4).[9]
- A recent study of the decrease in US deaths due to CHD from 1980 to 2000 suggests that approximately 47% of the decrease was attributed to evidence-based medical therapies and 44% to changes in risk factors in the population.[10]

Out-of-Hospital Cardiac Arrest

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

Cardiac arrest is defined as cessation of cardiac mechanical activity and is 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. The following information summarizes representative data from several sources in an attempt to characterize the incidence and outcome of out-of-hospital cardiac arrest.

- According to NCHS Data Warehouse mortality data, 310 000 CHD deaths occur out of hospital or in hospital emergency departments (EDs) annually (2004, ICD-10 codes I20–I25).[12]
- The annual incidence of out-of-hospital cardiac arrest in North America is approximately 0.55 per 1000 population.[13,14] With an estimated US population of 302 196 872 (www.census.gov, accessed June 27, 2007), this implies that approximately 166 200 out-of-hospital cardiac arrests occur annually.
- Approximately 60% of unexpected cardiac deaths are treated by emergency medical services (EMS).[15]
- In a population ≥20 years of age, the incidence of out-of-hospital cardiac arrest treated by EMS is from 36 to 81 per 100 000.[15,16]

  — Of these, 20% to 38% have ventricular fibrillation or ventricular tachycardia as the first recorded rhythm.[13,16]

- The incidence of cardiac arrest with an initial rhythm of ventricular fibrillation is decreasing over time[16]; however, the incidence of cardiac arrest with any initial rhythm is not decreasing.[16]
- The median reported survival to discharge after out-of-hospital cardiac arrest with any first recorded rhythm is 6.4%.[17]
- The average proportion of cases of out-of-hospital cardiac arrest that receive bystander cardiopulmonary resuscitation is 27.4%.[17]
- The incidence of lay-responder defibrillation is low (2.05% in 2002) but increasing over time.[18]

- The reported incidences of out-of-hospital pediatric cardiac arrest vary widely (from 2.6 to 19.7 annual cases per 100 000).[19]
- In 2004, 5891 people died of unintentional choking or suffocation. Of these, 725 were $<$1 year of age (NCHS).
- For adults, the reported incidence of cardiac arrest in hospital was 0.17 ($\pm$0.09) per bed per year.[20]
- The rates of survival to discharge after in-hospital cardiac arrest are 27% among children and 18% among adults.[21]

Pediatric/Children

- There are 72 293 812 individuals $<$18 years of age in the United States[22]; this implies that there are from 1900 to 14 200 pediatric out-of-hospital cardiac arrests annually of all causes (including trauma, sudden infant death syndrome, respiratory causes, cardiovascular causes, and submersion).
- Ventricular fibrillation is an uncommon cause of cardiac arrest in children but is observed in approximately 5% to 15% of children with out-of-hospital cardiac arrest.[23]
- 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.[24,25] Although incomplete, these numbers provide a basis for estimating the number of deaths in this age range.
- One report describes the incidence of nontraumatic pediatric cardiac arrest (among students $\geq$3 and $\leq$18 years of age) that occurs in schools and estimates rates (per 100 000 person-school-years) for elementary, middle, and high schools to be 0.18, 0.19, and 0.15, respectively, for the geographic area (King County, Washington) and time frame (January 1, 1990, to December 31, 2005) studied.[26]
- The reported average rate of survival to discharge after pediatric out-of-hospital cardiac arrest is 6.7%.[19]

Awareness of Warning Signs and Risk Factors for CVD

- Surveys conducted by the American Heart Association in 1997, 2000, 2003, and 2006 to evaluate trends in women's awareness, knowledge, and perceptions related to CVD found that in 2006, awareness of HD as the leading cause of death among women was 57%, significantly higher than in prior surveys. Awareness was lower among black and Hispanic women than among white women, and the racial/ethnic difference has not changed appreciably over time. More than twice as many women felt uninformed about stroke, compared with HD, in 2006. Hispanic women were more likely than white women to report that there is nothing they can do to keep themselves from getting CVD. The majority of respondents reported confusion related to basic CVD prevention strategies.[27]
- Nearly 875 students in 4 Michigan high schools were given a survey to obtain data on the perception of risk factors and other knowledge-based assessment questions about CVD. Accidents were rated as the greatest perceived lifetime health risk (39%). Nearly 17% selected CVD as the greatest lifetime risk, making it the third most popular choice after accidents and cancer. When asked to identify the greatest cause of death for each sex, 42% correctly recognized CVD for men, and 14% correctly recognized CVD for women; 40% incorrectly chose a substance abuse/use behavior, other than cigarettes, as the most important CVD risk behavior.[28]
- A nationally representative sample of women were given a questionnaire about history of CVD risk factors, self-reported actions taken to reduce risk, and barriers to heart health. The rate of awareness of CVD as the leading cause of death has nearly doubled since 1997, was significantly greater for whites than for blacks and Hispanics, and was independently correlated with increased physical activity (PA) and weight loss in the previous year. Fewer than half of respondents were aware of healthy levels of risk factors. Awareness that their personal level was not healthy was positively associated with action. Most women took steps to lower risk in family members and themselves.[29]

Risk Factors

- Data from the 2003 CDC BRFSS survey of adults $\geq$18 years of age showed the prevalence of respondents who reported having $\geq$2 risk factors for HD and stroke increased among successive age groups. The prevalence of having $\geq$2 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 $\geq$\$50 000 had the lowest prevalence (28.8%), and those reporting household income of $\leq$\$10 000 had the highest prevalence (52.5%). Adults who reported being unable to work had the highest prevalence (69.3%) of $\geq$2 risk factors, followed by retired persons (45.1%), unemployed adults (43.4%), homemakers (34.3%), and employed persons (34.0%). Prevalence of $\geq$2 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 $\geq$40%: Alabama, Arkansas, Georgia, Indiana, Kentucky, Louisiana, Mississippi, North Carolina, Ohio, Oklahoma, Tennessee, West Virginia, Guam, and Puerto Rico.[30]
- Data from the BRFSS (CDC) showed that young women and men 18 to 24 years of age 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 (65 to 74 years of age) 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).[31]

- Data from the Chicago Heart Association Detection Project (1967–1973, with an average follow-up of 31 years) showed that in younger women (18 to 39 years of age) with favorable levels for all 5 major risk factors (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 than for those who have unfavorable or elevated risk factor levels at young ages. Similar findings applied to men in this study.[32,33]
- Data from the BRFSS (CDC) showed that in adults ≥18 years of age, 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 regardless of educational status. CHD and stroke were inversely related to education, income, and poverty status. Hospitalization for total HD and acute MI was greater among men, but hospitalization for congestive heart failure (CHF) and stroke was greater among women. 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 in whites than in blacks by approximately 5 years. CVD mortality at all ages tended to be highest in blacks.[34]
- In respondents 18 to 74 years of age, 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 PA, 22.2%. The overall prevalence of the healthy lifestyle indicators (ie, having all 4 healthy lifestyle characteristics) was only 3%, with little variation among subgroups.[35]
- 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.[36]
- Analysis of FHS data among participants free of CVD at the age of 50 years 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 (see Table 2-4).[37]
- Analysis of >14 000 middle-aged subjects in the ARIC study of the NHLBI showed that >90% of CVD events in black subjects, compared with approximately 70% in white subjects, were explained by elevated or borderline risk factors. Furthermore, the prevalence of participants with elevated risk factors was higher in black subjects; after accounting for education and risk factors, the incidence of CVD was identical in black and white subjects. Thus, the observed higher CVD incidence rate in black subjects appears to be largely attributable to a greater prevalence of elevated risk factors. The primary prevention of elevated risk factors might largely eliminate the incidence of CVD, and these beneficial effects would be applicable not only for white but also for black subjects.[38]
- Data from the Medical Expenditure Panel Survey (MEPS) 2004 Full Year Data File showed that nearly 26 million US adults ≥18 years of age were told by a doctor that they had HD, stroke, or any other heart-related disease[39]:

— 56.6% of those surveyed said they engaged in moderate to vigorous PA 3 times per week; 57.9% of those surveyed who had not been told they had HD engaged in regular PA more than those who had been told they had HD (46.3%).

— 38.6% maintained a healthy weight. Among those told that they had HD, 33.9% had a healthy weight, as compared with 39.3% who had never been told they had HD.

— 78.8% do not currently smoke. Among those ever told that they had indicators of HD, 18.3% continued to smoke.

— More than 93% engaged in at least 1 recommended behavior for prevention of HD: 75.5% engaged in 1 or 2; 18% engaged in all 3; and 6.5% did not engage in any of the recommended behaviors.

○ Age-based variations

– Moderate to vigorous PA ≥3 times per week varied according to age. Younger people (18 to 44 years) were more likely (59.9%) than those who were older (45 to 64 and ≥65 years, 55.3% and 48.5%, respectively) to engage in regular PA.

– A greater percentage of those between 18 and 44 years of age had a healthy weight (43.7%) than did those 45 to 64 years of age and ≥65 years of age (31.4% and 37.3%, respectively).

– Those ≥65 years of age were more likely to be current nonsmokers (89.7%) than were people 18 to 44 years of age and 45 to 64 years of age (76.1% and 77.7%, respectively).

○ Race/ethnicity-based variations

– Non-Hispanic whites were more likely than Hispanics or non-Hispanic blacks to engage in moderate to vigorous PA (58.5% versus 51.4% and 52.5%, respectively)

– Non-Hispanic whites were more likely to have maintained a healthy weight than were Hispanics or non-Hispanic blacks (39.8% versus 32.1% and

29.7%, respectively)
    - Hispanics were more likely to be nonsmokers (84.2%) than were non-Hispanic whites and non-Hispanic blacks (77.8% and 76.3%, respectively).
- ○ Sex-based variations
    - Men were more likely to have engaged in moderate to vigorous PA ≥3 times per week than women (60.3% versus 53.1%, respectively).
    - Women were more likely than men to have maintained a healthy weight (45.1% versus 31.7%, respectively).
    - 81.7% of women did not currently smoke, compared with 75.7% of men.
- ○ Variations based on education level
    - A greater percentage of adults with at least some college education engaged in moderate to vigorous PA ≥3 times per week (60.8%) than did those with a high school education or less than a high school education (55.3% and 48.3%, respectively).
    - A greater percentage of adults with at least some college education had a healthy weight (41.2%) than did those with a high school or less than high school education (36.2% and 36.1%, respectively).
    - There was a greater percentage of nonsmokers among those with a college education (85.5%) than among those with a high school or less than high school education (73.8% and 69.9%, respectively).

- Forty-four percent of participants (18 to 64 years of age at baseline) in the Chicago Heart Association Detection Project in Industry without a history of MI were investigated to determine whether traditional CVD risk factors were similarly associated with CVD mortality in black and white men and women. In general, the magnitude and direction of associations were similar by race. Most traditional risk factors demonstrated similar associations with mortality in black and white adults of the same sex. Small differences were primarily in the strength, not the direction, of association.[40]

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 to improve healthy longevity.

- The lifetime risk for CVD and median survival were highly associated with risk factor burden at 50 years of age among >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 high 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 50 years of age, compared with 68.9% in men and 50.2% in women with ≥2 major risk factors at age 50. In addition, men and women with optimal risk factors had a median life expectancy ≥10 years longer than those with ≥2 major risk factors at age 50.[37]
- 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 85 years of age and beyond. Low levels of the major risk factors in middle age predicted overall survival and morbidity-free survival to the age of 85 years or longer.[41]
    - — Overall, 35.7% survived to the age of 85 years, and 22% survived to that age free of major morbidities.
    - — Factors associated with survival to the age of 85 years 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 the age of 85 years 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 years.
- A study of 366 000 men and women from the Multiple Risk Factor Intervention Trial (MRFIT) Study 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 rates, and 6 to 10 years' greater life expectancy.[33]
- 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 PA, 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 a 14-year period 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%.[42]

- Among individuals 70 to 90 years of age, adherence to a Mediterranean-style diet and greater PA are associated with 65% to 73% lower rates of all-cause mortality, as well as lower mortality rates due to CHD, CVD, and cancer.[43]
- Seventeen-year mortality data from the NHANES II Mortality Follow-Up Study indicated 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]) than for 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.[44]
- 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 (approximately 25 years later) and lower average annual Medicare costs at older ages.
  - — The presence of 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.[45]
  - — Similarly, the existence of 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).[46]

Hospital Discharges, Ambulatory Care Visits, and Nursing Home Visits

- From 1979 to 2005, the number of inpatient discharges from short-stay hospitals with CVD as the first-listed diagnosis increased 26% to 6 159 000 discharges (NCHS, NHDS). In 2005, CVD ranked highest among all disease categories in hospital discharges.[47]
- In 2005, there were 81 836 000 physician office visits with a primary diagnosis of CVD (NCHS, NAMCS).[48]
- In 2005, there were 4 036 000 visits to EDs with a primary diagnosis of CVD (NCHS, NHAMCS).[49]
- In 1999, 23% of nursing home residents ≥65 years of age had a primary diagnosis of CVD at admission. This was the highest disease category for these residents (NCHS, NNHS).[50]
- In 2005, there were 6 734 000 outpatient department visits with a primary diagnosis of CVD (NHAMCS).[51] In 2005, approximately 1 of every 6 hospital stays, or almost 6 million, resulted from CVD. The total inpatient hospital cost for CVD was $71.2 billion, approximately one fourth of the total cost of hospital care in the United States. The average cost per hospitalization was approximately 41% higher than the average cost for all stays. Hospital admissions that originated in the ED accounted for 60.7% of all hospital stays for CVD. This was 41% higher than the overall rate of 43.1%; 3.3% of patients admitted to the hospital for CVD died in the hospital, which was significantly higher than the average in-hospital death rate of 2.1%.[52]
- Coronary atherosclerosis involved 1.2 million hospital stays and was the most expensive condition treated. This condition resulted in >$44 billion in expenses. More than half of the hospital stays for coronary atherosclerosis were among patients who also received percutaneous coronary intervention or cardiac revascularization (coronary artery bypass graft [CABG]) during their stay. Acute MI resulted in $31 billion of hospital charges for 695 000 hospital stays. The 1.1 million hospitalizations for CHF amounted to nearly $29 billion in hospital charges.[53]
- In 2003, approximately 48.3% of hospital stays for CVD were for women, who accounted for 42.8% of the national cost ($187 billion) associated with these conditions. Although only 40% of hospital stays for acute MI and coronary atherosclerosis were for women, more than half of all stays for nonspecific chest pain, congestive HF, and stroke were for women. There was no difference between men and women in hospitalizations for cardiac dysrhythmias.[54]
- Circulatory disorders were the most frequent reason for admission to the hospital through the ED, accounting for 26.3% of all admissions through the ED. After pneumonia, which was ranked first, the most common heart-related conditions were CHF (2), chest pain (3), hardening of the arteries (4), and heart attack (5), which together accounted for >15% of all admissions through the ED. Stroke and irregular heart beat ranked seventh and eighth, respectively.[55]

Cost

- The estimated direct and indirect cost of CVD for 2008 is $448.5 billion.
- In 2003, $31.7 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 $8966 per discharge.[56]
- A study of the 1987 National Medicaid Expenditure Survey and the 2000 MEPS, 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%.[57]

Operations and Procedures

- In 2005, an estimated 6 989 000 inpatient cardiovascular operations and procedures were performed in the United States; 4.1 million were performed on males, and 2.9 million were performed on females (NHDS, NCHS).[47]

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Table 2-1. Cardiovascular Disease

Population Group	Prevalence, 2005 Age ≥20 y	Mortality, 2004 All Ages*	Hospital Discharges, 2005 All Ages	Cost, 2008
Both sexes	80 700 000 (37.1%)	869 724	6 159 000	$448.5 billion
Males	37 900 000 (37.5%)	410 628 (47.2%)†	3 136 000	...
Females	42 700 000 (36.6%)	459 096 (52.8%)†	3 023 000	...
NH white males	37.2%	353 129	...	...
NH white females	35.0%	396 503	...	...
NH black males	44.6%	48 083	...	...
NH black females	49.0%	53 850	...	...
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 and include Hispanics.

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

Sources: Prevalence: NHANES 1999–2004 NCHS and NHLBI. Percentages for racial/ethnic groups are age-adjusted for Americans 20 years of age and older. These data are based on self-reports. Estimates from NHANES 1999–2004 (NCHS) are applied to 2005 population estimates 20 years of age and older. Mortality: NCHS. These data represent underlying cause of death only. 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 2008.

Table 2-2. 2004 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‖ 1994 to 2004	Rank§	Death Rate	% Change‖ 1994 to 2004	Rank§	Death Rate	% Change‖ 1994 to 2004
Alabama	50	364.2	−11.2	24	135.2	−24.9	50	64.8	−5.7
Alaska	2	223.4	−29.9	4	95.5	−37.6	30	51.4	−29.2
Arizona	13	248.3	−23.2	26	139.5	−27.7	10	43.3	−26.4
Arkansas	46	338.2	−17.2	46	174.9	−21.4	52	65.1	−24.3
California	28	276.4	−22.9	33	150.8	−32.1	32	52.8	−21.3
Colorado	4	233.9	−23.4	8	110.6	−33.1	14	44.2	−21.1
Connecticut	7	239.6	−31.2	12	122.6	−36.2	2	37.8	−28.8
Delaware	33	292.7	−22.6	40	161.2	−27.1	6	40.5	−20.4
District of Columbia	45	336.8	−14.2	49	182.9	+19.4	4	38.8	−46.8
Florida	24	265.7	−22.0	36	153.8	−28.9	8	41.9	−24.8
Georgia	42	324.3	−20.5	20	128.5	−34.6	46	59.8	−21.7
Hawaii	3	230.4	−24.2	3	91.1	−36.5	18	47.3	−19.1
Idaho	19	256.8	−21.0	10	120.4	−30.7	35	53.9	−19.8
Illinois	31	290.2	−27.4	31	149.2	−37.1	26	50.1	−26.4
Indiana	38	306.0	−25.1	32	150.4	−33.8	36	53.9	−29.0
Iowa	23	262.6	−25.5	30	147.6	−33.8	24	49.4	−20.7
Kansas	27	272.6	−21.5	15	124.2	−31.8	31	51.5	−19.0
Kentucky	44	334.9	−19.3	42	163.9	−28.5	42	58.0	−19.2
Louisiana	47	338.8	−18.8	39	158.3	−29.7	44	59.3	−17.5
Maine	20	257.2	−27.6	14	123.8	−38.9	27	50.8	−14.3
Maryland	30	282.7	−21.0	35	151.7	−24.9	29	51.3	−21.1
Massachusetts	10	243.9	−26.6	9	116.7	−36.3	9	42.6	−19.5
Michigan	39	307.3	−24.7	44	166.3	−33.0	25	50.0	−28.2
Minnesota	1	211.1	−33.6	1	90.0	−44.7	16	46.2	−34.5
Mississippi	52	381.9	−18.6	43	164.6	−31.8	45	59.7	−16.8
Missouri	43	324.4	−20.7	45	169.5	−29.0	40	55.8	−19.9
Montana	6	237.4	−23.9	5	102.3	−32.0	15	45.6	−27.8
Nebraska	17	254.8	−30.0	6	106.4	−40.4	20	47.8	−22.7
Nevada	41	314.0	−20.6	21	128.8	−37.4	34	53.6	−17.2
New Hampshire	22	261.1	−28.0	29	143.2	−34.9	12	43.7	−34.0
New Jersey	25	270.9	−26.0	38	155.1	−31.8	5	39.3	−29.7
New Mexico	8	239.6	−22.7	13	122.8	−27.1	7	40.6	−32.4
New York	34	297.6	−28.3	51	195.3	−31.2	1	32.7	−31.8
North Carolina	35	298.0	−24.4	28	143.1	−34.0	48	60.9	−27.5
North Dakota	11	247.9	−27.3	23	132.8	−25.0	37	54.3	−23.5
Ohio	37	305.5	−23.6	41	162.0	−31.4	28	51.1	−17.4
Oklahoma	51	367.6	−10.9	52	208.8	−11.2	47	60.4	−10.9
Oregon	15	250.8	−24.8	7	108.8	−37.7	43	58.1	−25.7
Pennsylvania	32	291.2	−26.8	34	151.5	−34.5	19	47.3	−24.2
Puerto Rico¶	9	243.5	−19.5	11	122.2	−12.6	22	48.2	−17.6
Rhode Island	26	271.6	−23.3	48	181.0	−24.8	3	38.4	−30.2
South Carolina	40	308.5	−27.7	25	136.5	−38.2	51	64.9	−28.4
South Dakota	16	252.5	−27.7	27	141.4	−33.1	21	47.8	−24.2
Tennessee	49	349.1	−18.3	50	189.5	−23.9	49	64.5	−24.8
Texas	36	301.3	−19.5	37	154.4	−28.8	41	56.3	−19.0
Utah	5	237.3	−19.3	2	90.4	−38.6	17	46.9	−21.1
Vermont	12	247.9	−31.5	22	129.1	−38.2	11	43.6	−32.6
Virginia	29	281.6	−27.4	19	128.2	−33.5	39	55.2	−24.7
Washington	14	249.1	−22.7	17	126.2	−25.9	33	53.4	−21.3
West Virginia	48	344.5	−19.5	47	177.5	−27.5	38	54.4	−12.7
Wisconsin	21	260.8	−26.8	16	125.2	−36.2	23	48.9	−29.6
Wyoming	18	256.6	−22.7	18	128.0	−31.6	13	43.9	−30.5
Total United States		288.0	−24.7		150.2	−31.6		51.1	−24.2

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

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

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

§Rank is lowest to highest.

‖Percent change is based on log linear slope of rates for each year, 1994–2004. For stroke, the death rates in 1994–1998 were comparability modified with the ICD-10 to ICD-9 comparability ratio of 1.0502.

¶Percent changes for Puerto Rico are for 1996–1998 (averaged) to 2004 and are not based on a log linear slope.

Source: NCHS compressed mortality file 1979–2004. Data provided by personal communication with NHLBI.

Note: The Agency for Healthcare Research and Quality 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).[59] In addition, the Women's Health and Mortality Chartbook of the NCHS has state-related data for women.[60] Metropolitan/Micropolitan Area risk data are available for 500 such areas nationwide.[61] BRFSS data are also collected within each state.[62] In addition, the NCHS has "Health Data for All Ages by State."[63]

Table 2-3. International Death Rates (Revised 2007): Death Rates (Per 100 000 Population) for Total Cardiovascular Disease, Coronary Heart Disease, Stroke, and Total Deaths in Selected Countries (Most Recent Year Available)

	CVD Deaths	CHD Deaths	Stroke Deaths	Total Deaths
Men, Ages 35–74 y				
Russian Federation (2002)	1555	835	453	3187
Bulgaria (2004)*	916	273	227	1610
Romania (2004)	770	314	251	1652
Hungary (2003)	714	358	181	1860
Poland (2003)	557	228	118	1484
Czech Republic (2004)	481	231	94	1248
China Rural (1999)*	413	64	243	1260
Argentina (2001)	406	120	103	1262
China Urban (1999)*	389	106	217	1003
Scotland (2002)	373	247	61	1084
Ireland (2002)	337	217	41	875
Finland (2004)	334	211	54	921
Colombia (1999)	331	168	95	1021
Northern Ireland (2002)	322	217	53	876
Greece (2003)*	311	166	68	784
England/Wales (2002)	301	196	49	811
Belgium (1997)*	289	143	50	991
United States (2004)	**289**	**174**	**35**	**907**
Denmark (2001)	286	142	52	956
New Zealand (2000)	279	190	40	779
Germany (2004)	271	142	39	846
Portugal (2003)	253	97	96	967
Sweden (2002)	247	151	44	686
Republic of Korea (2002)	236	57	143	1085
Mexico (2001)	235	130	58	1056
Austria (2004)	226	131	34	818
The Netherlands (2004)	222	96	37	759
Italy (2002)*	218	101	41	744
Norway (2003)	217	125	36	720
Canada (2002)	212	142	28	741
Spain (2003)	205	101	43	822
Australia (2002)	196	127	30	659
France (2002)	183	73	35	896
Switzerland (2002)	181	97	23	674
Israel (2003)	180	95	38	717
Japan (2003)	170	53	66	694
Women Ages 35–74 y				
Russian Federation (2002)	659	288	257	1192
Bulgaria (2004)*	435	100	133	746
Romania (2004)	403	134	166	787
Hungary (2003)	303	133	91	807
China Rural (1999)*	279	41	152	799
China Urban (1999)*	273	71	147	663
Colombia (1999)	230	95	71	640
Poland (2003)	222	68	63	617
Czech Republic (2004)	213	82	52	594
Scotland (2002)	183	98	48	649
Argentina (2001)	174	35	55	617
Mexico (2001)	166	69	47	713
Northern Ireland (2002)	150	79	41	534
United States (2004)	**150**	**73**	**27**	**575**
England/Wales (2002)	138	68	36	509
New Zealand (2000)	136	71	33	498
Greece (2003)*	134	46	44	364
Republic of Korea (2002)	133	24	87	452
Ireland (2002)	130	66	27	502
Denmark (2001)	127	51	37	642
Belgium (1997)*	126	44	35	494
Portugal (2003)	123	35	55	449
Germany (2004)	111	45	23	426
Sweden (2002)	107	51	30	422
Finland (2004)	104	48	32	412
The Netherlands (2004)	102	34	26	466
Canada (2002)	92	48	20	452
Italy (2002)*	92	29	25	372
Austria (2004)	90	42	19	405
Norway (2003)	88	38	25	430
Australia (2002)	85	43	20	390
Israel (2003)	83	31	22	431
Spain (2003)	79	26	23	343
Switzerland (2002)	71	27	15	362
Japan (2003)	69	16	31	302
France (2002)	66	16	18	389

Note: Rates adjusted to the European Standard population.

*Countries using ICD-9. ICD-9 codes are 390–459 for cardiovascular disease, 410–414 for coronary heart disease, and 430–438 for stroke. ICD-10 codes are I00–I99 for cardiovascular disease, I20–I25 for coronary heart disease, and I60–I69 for stroke.

Sources: The World Health Organization Web page,[64] NCHS, and NHLBI.

Table 2-4. Remaining 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 Donald Lloyd-Jones, based on FHS data.

†Age 55.

‡Age 65.

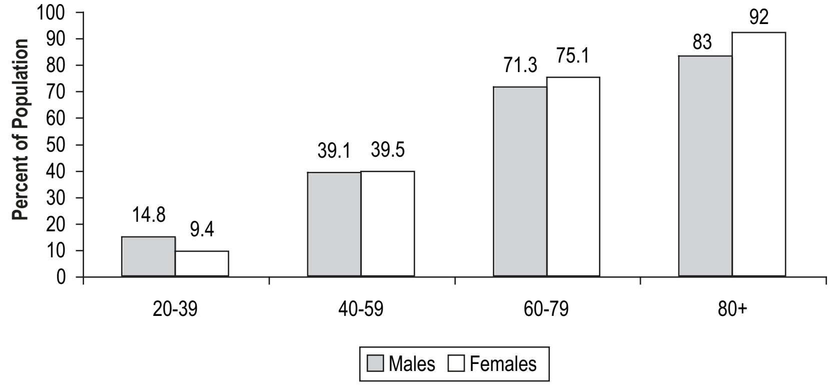


Chart 2-1. Prevalence of CVD in adults ≥20 years of age according to age and sex (NHANES 1999–2004). Source: NCHS and NHLBI. These data include CHD, HF, stroke, and hypertension.

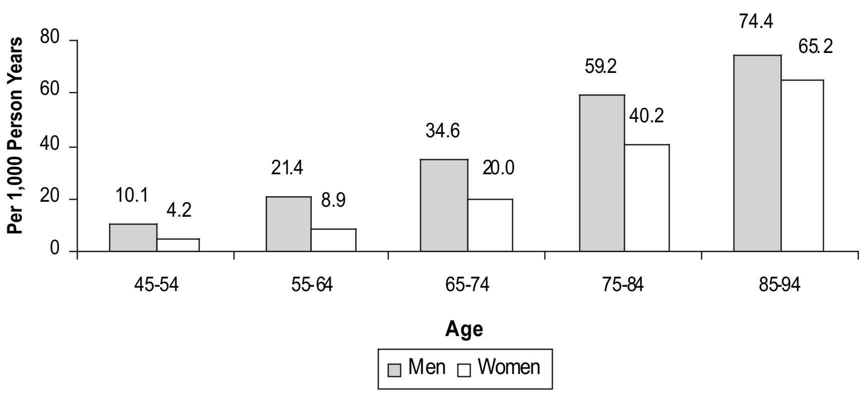


Chart 2-2. Incidence of CVD (CHD, HF, stroke, or intracerebral hemorrhage; does not include hypertension alone) by age and sex (FHS, 1980–2003). Source: NHLBI.[2]

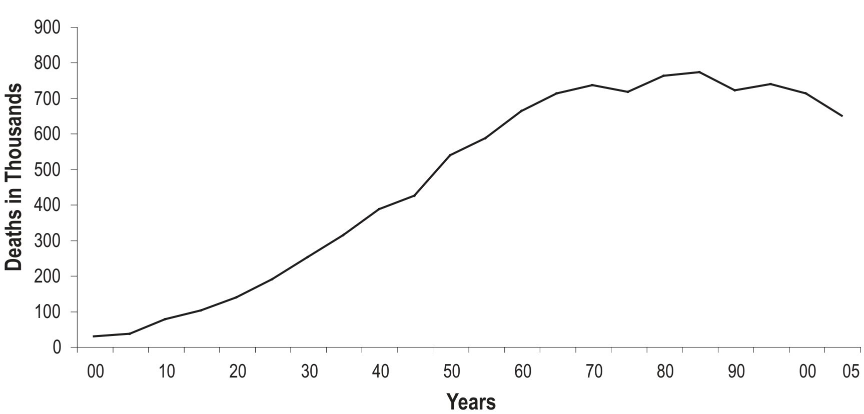


Chart 2-3. Deaths due to diseases of the heart (United States: 1900–2005). See Glossary for an explanation of "disease of the heart." The 2005 mortality rate is preliminary. Source: Respective National Vital Statistic Reports; NCHS and NHLBI.

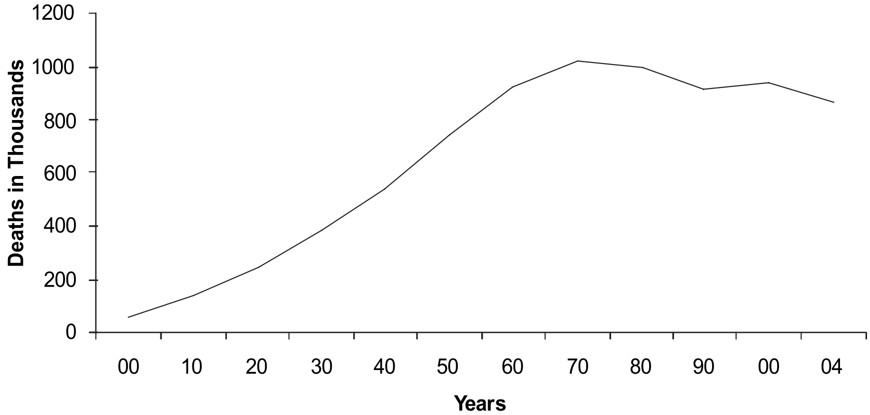


Chart 2-4. Deaths due to CVD (United States: 1900–2004). CVD does not include congenital HD.

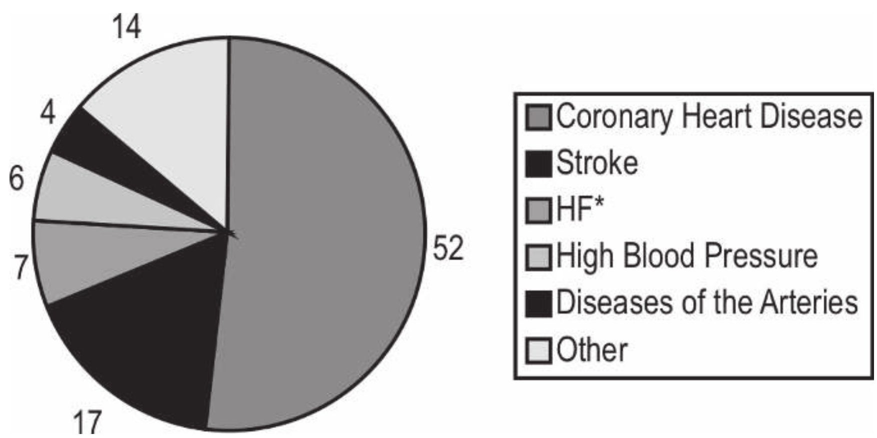


Chart 2-5. Percentage breakdown of deaths due to CVD (United States: 2004). Source: NCHS and NHLBI. *Not a true underlying cause.

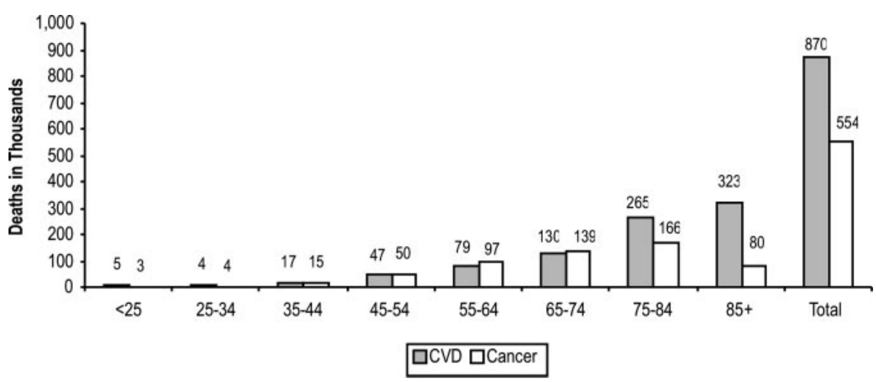


Chart 2-6. CVD deaths vs cancer deaths by age (United States: 2004). Source: NCHS and NHLBI.

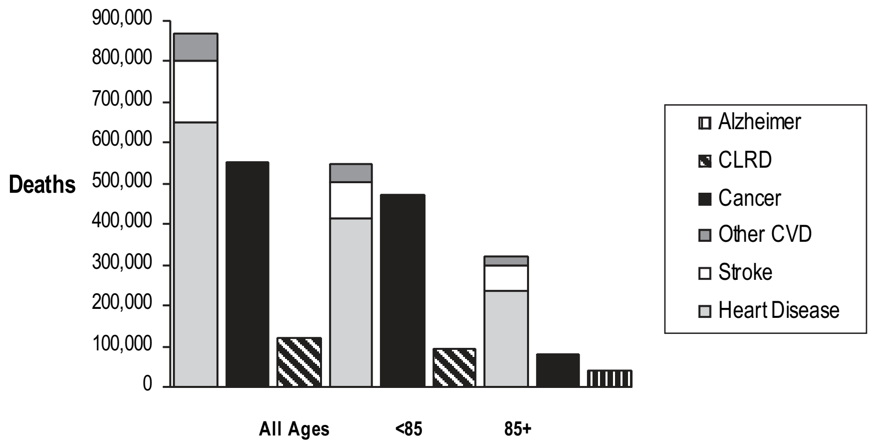


Chart 2-7. CVD and other major causes of death: total, <85 years of age, and ≥85 years of age. Deaths among both sexes, United States, 2004. Source: NCHS and NHLBI.

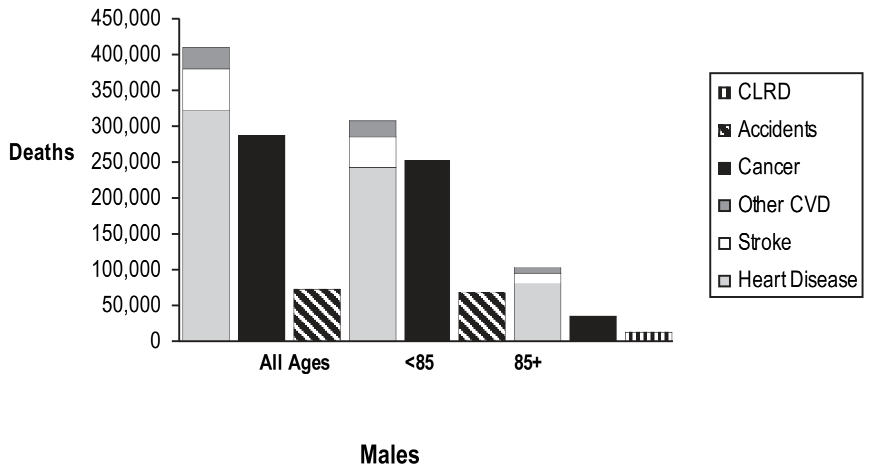


Chart 2-8. CVD and other major causes of death: total, <85 years of age, and ≥85 years of age. Deaths among males, United States, 2004. Source: NCHS and NHLBI.

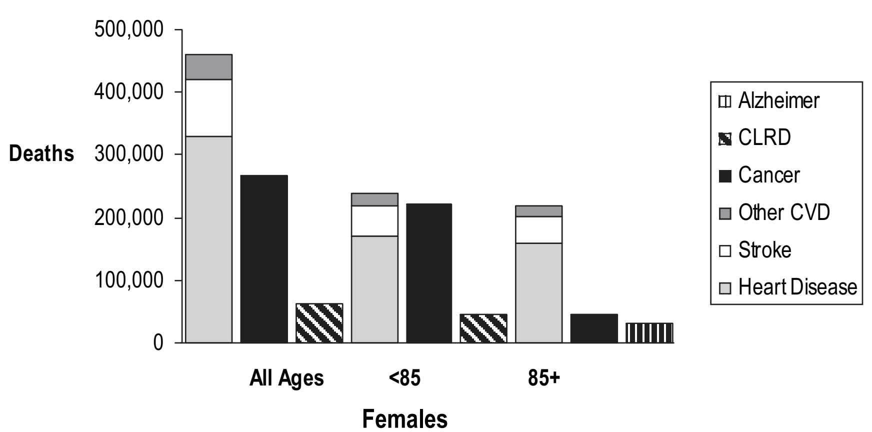


Chart 2-9. CVD and other major causes of death: total, <85 years of age, and ≥85 years of age. Deaths among females, United States, 2004. Source: NCHS and NHLBI.

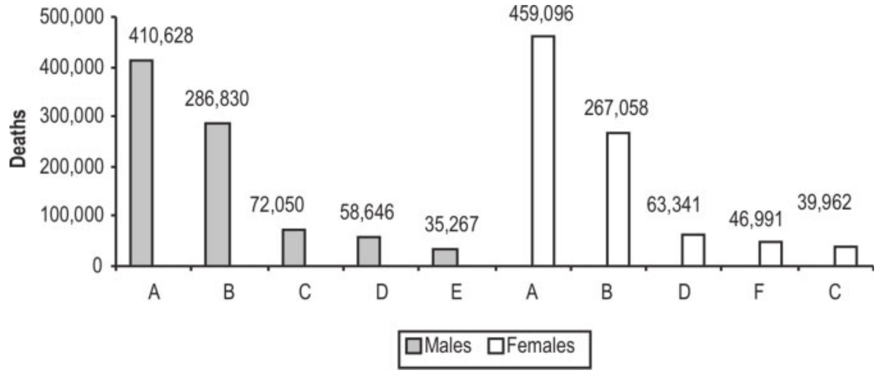


Chart 2-10. CVD and other major causes of death for all males and females (United States: 2004). A indicates total CVD; B, cancer; C, accidents; D, CLRD; E, diabetes mellitus; and F, Alzheimer's. Source: NCHS and NHLBI.

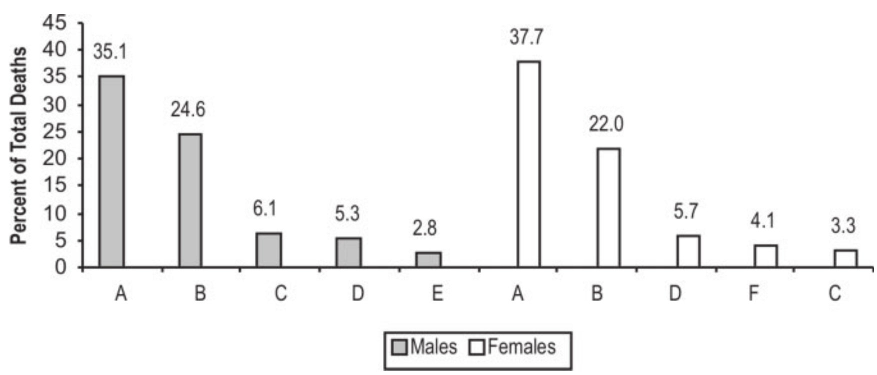


Chart 2-11. CVD and other major causes of death for white males and females (United States: 2004). A indicates total CVD plus congenital HD; B, cancer; C, accidents; D, CLRD; E, diabetes mellitus; and F, Alzheimer's. Note: Using "diseases of heart and stroke," which do not constitute total CVD, would make the percentages for the "A" bars 32.6 for males and 34.8 for females. Source: NCHS and NHLBI.

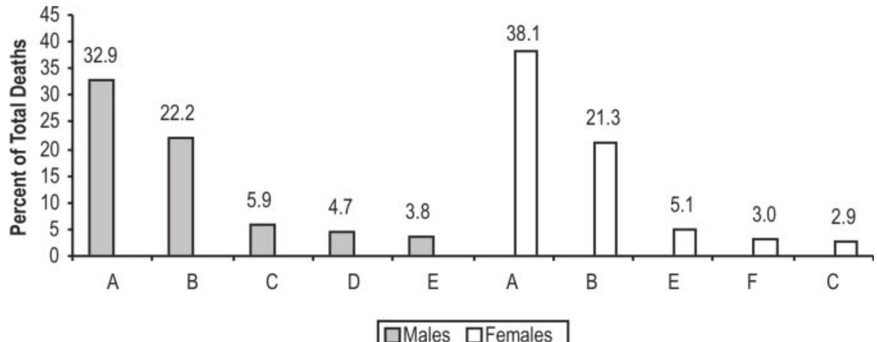


Chart 2-12. CVD and other major causes of death for black males and females (United States: 2004). A indicates total CVD plus congenital HD; B, cancer; C, accidents; D, assault (homicide); E, diabetes mellitus; and F, nephritis, etc. Note: Using "diseases of heart and stroke," which do not constitute total CVD, would make the percentages for the "A" bars 30.1 for males and 34.3 for females. Source: NCHS and NHLBI.

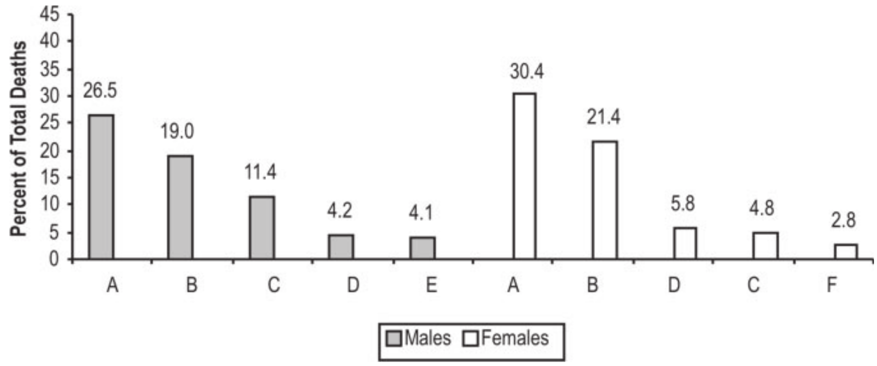


Chart 2-13. Diseases of the heart and stroke and other major causes of death for Hispanic or Latino males and females (United States: 2004). Data for total CVD are not available. A indicates diseases of the heart and stroke; B, cancer; C, accidents; D, diabetes mellitus; E, assault (homicide); and F, influenza and pneumonia. Source: NCHS and NHLBI.

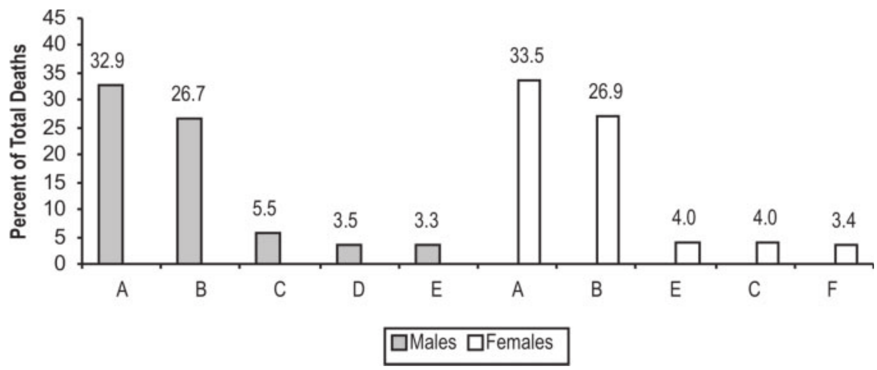


Chart 2-14. Diseases of the heart and stroke and other major causes of death for Asian or Pacific Islander males and females (United States: 2004). "Asian or Pacific Islander" is a heterogenous category that includes people at high CVD risk (eg, South Asian) and people at low CVD risk (eg, Japanese). More specific data for these groups are not available. Mortality data for total CVD are not available. A indicates diseases of the heart and stroke; B, cancer; C, accidents; D, CLRD; E, diabetes mellitus; and F, influenza and pneumonia. Source: NCHS and NHLBI.

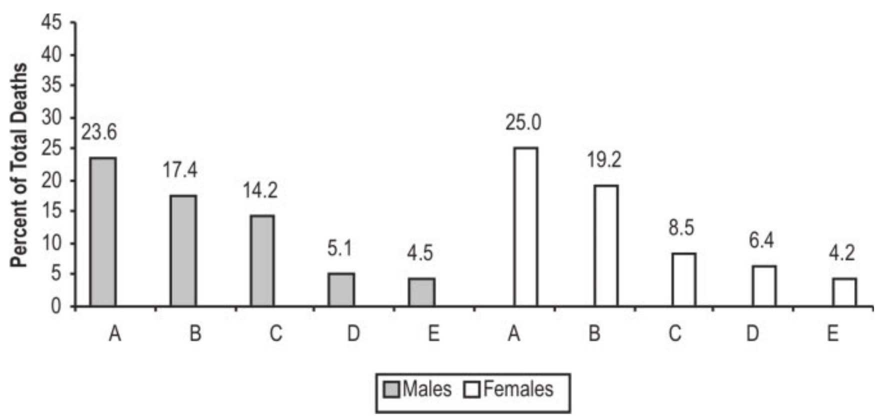


Chart 2-15. Diseases of the heart and stroke and other major causes of death for American Indian or Alaska Native males and females (United States: 2004). Data for total CVD are not available. A indicates diseases of the heart and stroke; B, cancer; C, accidents; D, diabetes mellitus; and E, chronic liver disease and cirrhosis. Source: NCHS and NHLBI.

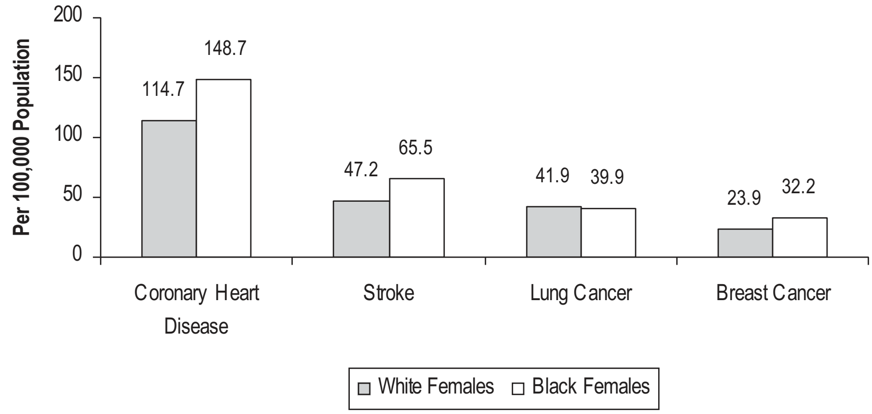


Chart 2-16. Age-adjusted death rates for CHD, stroke, and lung and breast cancer for white and black females (United States: 2004). Source: NCHS and NHLBI.

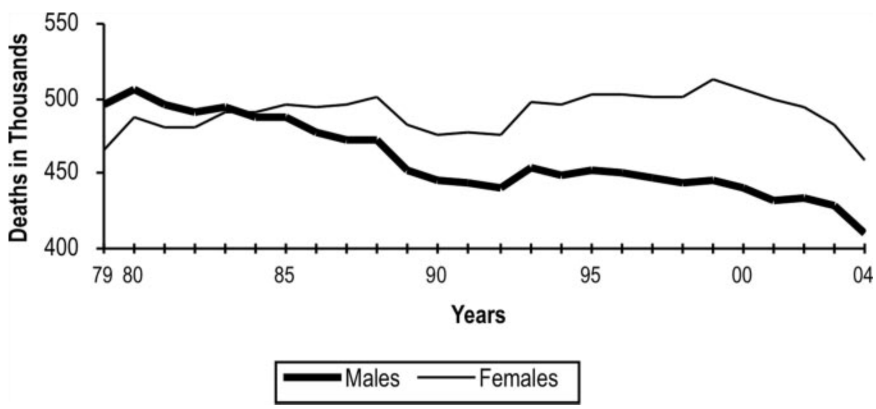


Chart 2-17. CVD mortality trends for males and females (United States: 1979–2004). Source: Annual Final Mortality, NCHS and NHLBI. The overall comparability for CVD between ICD-9 (1979–1998) and ICD-10 (1999–2004) is 0.9962. No comparability ratios were applied.

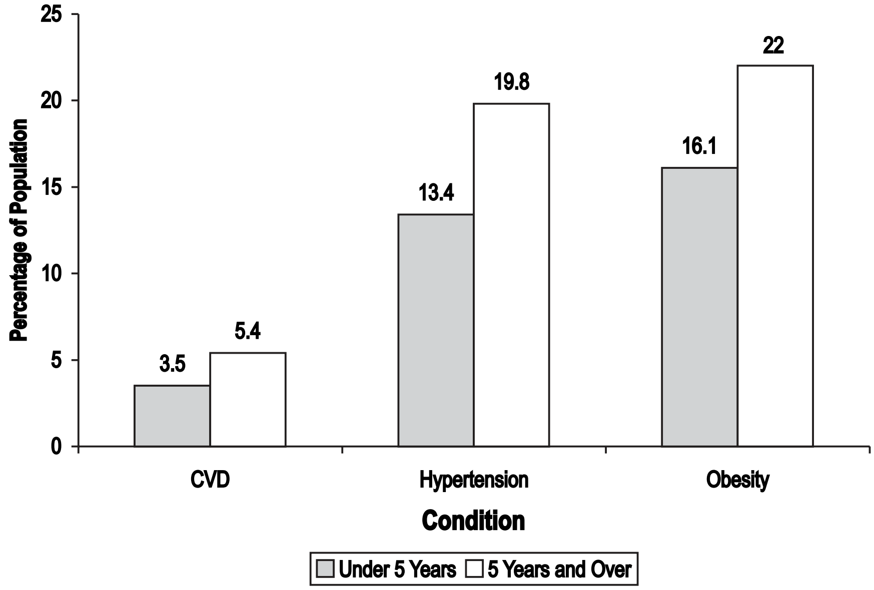


Chart 2-18. Percentage of foreign-born Hispanics, ≥18 years of age, with selected health conditions, by length of time living in the United States, 1998–2003. In this chart, CVD excludes hypertension. Source: MMWR.[58]

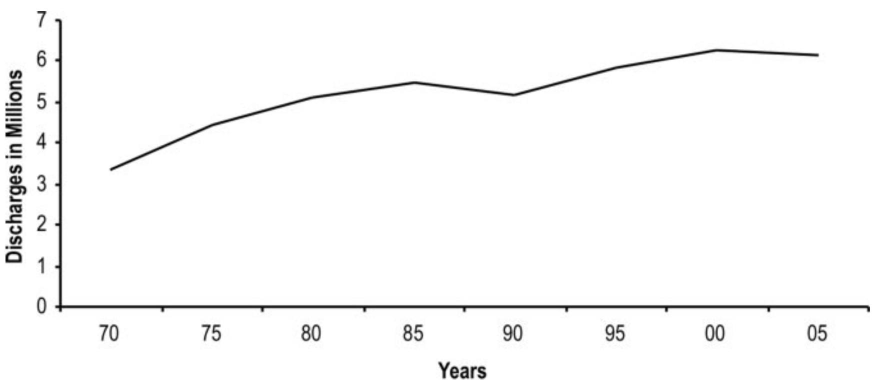
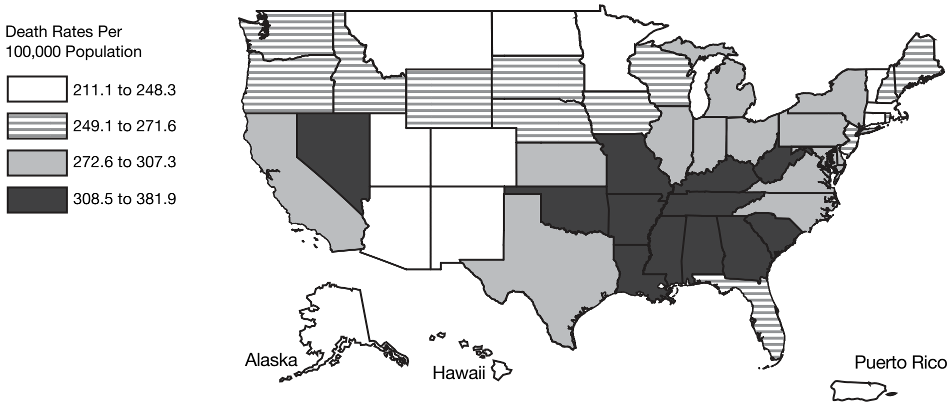


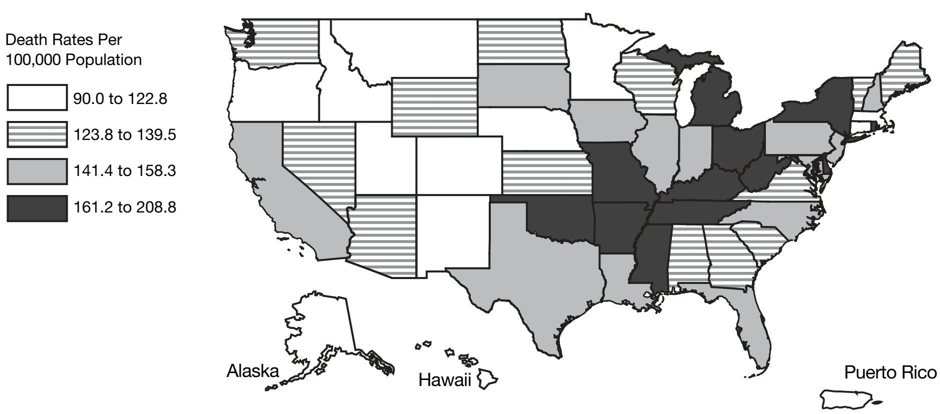
Chart 2-19. Hospital discharges for CVD (United States: 1970–2005). Hospital discharges include people discharged alive, dead, and "status unknown." Source: NCHS and NHLBI.

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

2004 Total Cardiovascular Disease Age-Adjusted Death Rates by State



2004 Coronary Heart Disease Age-Adjusted Death Rates by State



2004 Stroke Age-Adjusted Death Rates by State

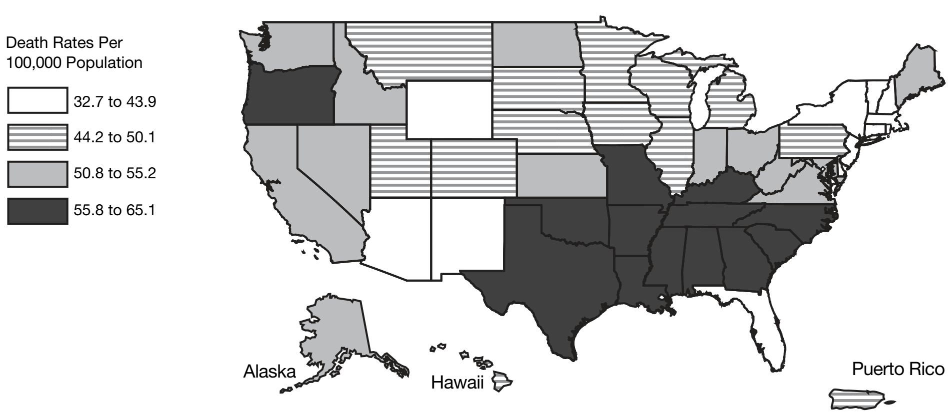


Chart 2-20. US maps corresponding to state death rates.

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 Tables 3-1 and 3-2. See Charts 3-1 through 3-8.

Prevalence

- Data from 2005 from the BRFSS survey of the CDC showed that 6.5% of respondents reported a history of CHD. Men had a significantly higher prevalence of MI history than women (5.5% versus 2.9%), angina/CHD (5.5% versus 3.4%), and 1 or more of these conditions (8.2% versus 5.0%). Prevalence of these conditions increased with age and decreased with higher education. Of persons with less than a high school education, 9.8% reported a history of 1 or more of these conditions, nearly twice the proportion among college graduates, 5.0%. American Indians/Alaska Natives and multiracial persons had substantially higher prevalences of a history of MI, angina/CHD, and 1 or more of these conditions than did non-Hispanic whites. The prevalences of all of these conditions among whites and blacks were similar. The prevalence of respondents with a history of MI ranged from 2.1% in the US Virgin Islands to 6.1% in West Virginia. Puerto Rico (8.5%) and West Virginia (7.3%) had the highest prevalence of angina/CHD history; Colorado (2.8%) and the US Virgin Islands (2.2%) had the lowest.[1]
- Combining the rates for possible and definite CHD shows that 17 to 25 of every 100 American Indian men 45 to 74 years of age have some evidence of heart disease.[2]

Abbreviations Used in Chapter 3

ACC	American College of Cardiology
ACS	acute coronary syndrome
AHA	American Heart Association
AMI	acute myocardial infarction
AP	angina pectoris
ARIC	Atherosclerosis Risk in Communities study
BMI	body mass index
BP	blood pressure
BRFSS	Behavior Risk Factor Surveillance System
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
GRACE	Global Registry of Acute Coronary Events
HF	heart failure
HMO	health maintenance organization
MET	metabolic equivalent
mg/dL	milligrams per deciliter
MI	myocardial infarction
mm Hg	millimeters of mercury
NAMCS	National Ambulatory Medical Care Survey
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
NHLBI	National Heart, Lung, and Blood Institute
NSTE ACS	non–ST-segment–elevation acute coronary syndromes
PA	physical activity
PCI	percutaneous coronary intervention
STEMI	ST-segment elevation MI
UA	unstable angina
WISE	Women's Ischemia Syndrome Evaluation

Incidence

- On the basis of unpublished data from the ARIC and CHS studies of the NHLBI:
  - — This year, an estimated 770 000 Americans will have a new coronary attack, and ≈430 000 will have a recurrent attack. It is estimated that an additional 190 000 silent first MIs occur each year.
  - — The estimated annual incidence of MI is 600 000 new attacks and 320 000 recurrent attacks.
  - — Average age at first MI is 64.5 years for men and 70.4 years for women.
- On the basis of the NHLBI's FHS:
  - — CHD makes up more than half of all cardiovascular events in men and women <75 years of age.[3]
  - — The lifetime risk of developing CHD after 40 years of age is 49% for men and 32% for women.[4]
  - — 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.[3]
- In the NHLBI's ARIC study, in participants 45 to 64 years of age, the 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. In a multivariable analysis, hypertension was a particularly strong risk factor in black women, with hazard rate ratios (95% 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).[5]
- The annual age-adjusted rates per 1000 population of first MI (1987–2001) in ARIC Surveillance (NHLBI) were 4.2 in black men, 3.9 in white men, 2.8 in black women, and 1.7 in white women.[6]

- Among American Indians 65 to 74 years of age, the annual rates per 1000 population of new and recurrent MIs were 7.6 for men and 4.9 for women.[2]
- Analysis of data from NHANES III and NHANES 1999–2002 (NCHS) showed that in adults 20 to 74 years of age, the overall distribution of 10-year risk of developing CHD changed little during this time. Among the 3 racial/ethnic groups, blacks had the highest proportion of participants in the high-risk group.[7]

Mortality

CHD caused 1 of every 5 deaths in the United States in 2004. CHD mortality was 451 326. CHD total mention mortality was 607 000. MI mortality was 156 816. MI total mention mortality was 196 000 (Vital Statistics of the United States, NCHS). CHD is the largest major killer of American males and females.[8] 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 50 to 79 years of age who had cardiac arrest showed that the incidence of out-of-hospital cardiac arrest was 6.0/1000 subject-years in subjects with any clinically recognized heart disease, 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 FHS data (NHLBI) 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 150.2 per 100 000 population. The death rates were 194.2 for white males and 223.9 for black males; for white females, the rate was 114.7, and for black females it was 148.7.[8]
  - — The 2004 death rates for CHD were 119.2 for Hispanics or Latinos, 106.5 for American Indians or Alaska Natives, and 84.1 for Asians or Pacific Islanders.[11]
- About 82% of people who die of CHD are ≥65 years of age (NCHS; AHA computation).
- The estimated average number of years of life lost because of an MI is 15.[12]
- On the basis of data from the FHS of the NHLBI[3]:
  - — Fifty percent of men and 64% of women who die suddenly of CHD have 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.
- 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%.
  - — Mortality increases for every 30 minutes that elapse before a patient with ST-segment elevation is recognized and treated.
- CHD death rates have fallen from 1968 to the present. Analysis of NHANES (NCHS) data compared CHD death rates between 1980 and 2000 to determine how much of the decline in deaths from CHD over that period could be explained by the use of medical and surgical treatments versus changes in CVD risk factors (resulting from lifestyle/behavior). After comparing 1980 and 2000, it was estimated that ≈47% of the decrease in CHD deaths was attributable to treatments, including[14]:
  - — secondary preventive therapies after MI or revascularization (11%),
  - — initial treatments for AMI or unstable angina (10%),
  - — treatments for HF (9%),
  - — revascularization for chronic angina (5%),
  - — and other therapies (12%), including antihypertensive and lipid-lowering primary prevention therapies.
- It was also estimated that a similar amount of the reduction in CHD deaths, ≈44%, was attributable to changes in risk factors, including[14]:
  - — lower total cholesterol (24%),
  - — lower systolic BP (20%),
  - — lower smoking prevalence (12%),
  - — and increased physical inactivity (5%).

However, these favorable improvements in risk factors were partially offset by increases in BMI and in diabetes prevalence, which accounted for an increased number of deaths (8% and 10%, respectively).

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.[15]
- According to a case-control study of 52 countries (INTERHEART), optimization of 9 easily measured and potentially modifiable risk factors could result in a 90% reduction in 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, low daily fruit and vegetable consumption, alcohol overconsumption, and psychosocial index.[16]

- A study of >3000 members of the FHS (NHLBI) 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 increment in exercise capacity reduced risk by 13%.[17]
- 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 (NCHS) surveys conducted in 1971–1975, 1976–1980, 1988–1994, and 1999–2000.[18]
  - 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 65 to 74 years of age (3%) and was progressively greater at younger ages (29% at 25 to 34 years of age), 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%) compared with favorable systolic BP (from 32% to 47%), nonsmoking (from 60% to 79%), and favorable cholesterol (from 33% to 46%).
- A study of non-Hispanic white persons 35 to 74 years of age in the FHS (NHLBI) and the NHANES III (NCHS) studies showed that 26% of men and 41% of women had at least 1 borderline risk factor in NHANES III. It is estimated that >90% of CHD events will occur in individuals with at least 1 elevated risk factor and that approximately 8% will occur in people with only borderline levels of multiple risk factors. Absolute 10-year CHD risk exceeded 10% in men over 45 years of age who had 1 elevated risk factor and ≥4 borderline risk factors and in those who had ≥2 elevated risk factors. In women, absolute CHD risk exceeded 10% only in those over 55 years of age who had at least 3 elevated risk factors.[19]
- Analysis of data from the CHS study (NHLBI) among participants ≥65 years of age 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.[20]

Awareness of Warning Signs and Risk Factors for Heart Disease

- Data from the Women Veteran Cohort showed that 42% of women ≥35 years of age were concerned about heart disease. Only 8% to 20% were aware that coronary artery disease is the major cause of death for women.[21]
- 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.[22]
- 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.[23]
- A recent community surveillance study in 4 US communities reported that in 2000 the overall proportion of persons with delays of ≥4 hours from onset of acute MI symptoms 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 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.[24]
- A survey of over 500 internists and OB/GYNs attending presentations developed for the NY State Women and Heart Disease Physician Education Initiative found that 71.5% correctly responded to 13 questions assessing knowledge of coronary risk prevention. Of the attendees, 71.5% were internists, and 42.7% were women. Almost one third of internists and half of OB/GYNs did not know that tobacco use was the leading cause of MI in young women. For patients who smoked tobacco, only two thirds of internists and 55.4% of OB/GYNs reported suggesting a quit date.[25]
- A study of the perceptions of susceptibility and seriousness of heart disease and the relationships between socioeconomic status, age, and knowledge of heart disease and its risk factors was conducted among 194 educated black women. Participants did not perceive themselves to be at high risk for developing heart disease, although they did perceive heart disease as serious. Black women who were older perceived heart disease to be more serious than their younger counterparts. Older women and those with higher socioeconomic status knew more about heart disease and risk factors. Neither socioeconomic status nor age moderated the relationship between knowledge and perceived susceptibility or seriousness.[26]
- According to 2003 data from the BRFSS (CDC), 36.5% of all women surveyed had multiple risk factors for heart disease and stroke. The age-standardized prevalence of multiple risk factors was lowest in whites and Asians. After adjustment for age, income, education, and health coverage, the odds for multiple risk factors were greater in black and Native American women and lower for Hispanic women as compared with white women. Prevalence estimates and odds of multiple risk factors increased with age; decreased with education, income, and employment; and

were lower in those with no health coverage. Smoking was more common in younger women, whereas older women were more likely to have medical conditions and to be physically inactive.[27]

- In an effort to understand why women delay seeking treatment for symptoms of an acute MI, 30 interviews were conducted to determine black, Hispanic, and white women's perceptions of heart disease risk and whether differences existed on the basis of the participants' race or ethnicity. Perceptions of heart disease risk were similar between groups, with women generally believing that they were at risk for heart disease because of family history, diet, and obesity. Racial and ethnic differences were noted, however, in risk reduction and anticipated treatment-seeking behaviors.[28]

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. Among these people, the risk of another MI, sudden death, AP, HF, and stroke—for both men and women—is substantial (FHS, NHLBI).[3]
- 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 ≥70 years of age participated in cardiac rehabilitation, compared with 66% of 60- to 69-year-olds and 81% of those <60 years of age.[29]
- On the basis of pooled data from the FHS, ARIC, and CHS studies of the NHLBI, within 1 year after a first MI:

  — At ≥40 years of age, 18% of men and 23% of women will die.
  — At 40 to 69 years of age, 8% of white men, 12% of white women, 14% of black men, and 11% of black women will die.
  — At ≥70 years of age, 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 ≥40 years of age, 33% of men and 43% of women will die.
  — At 40 to 69 years of age, 15% of white men, 22% of white women, 27% of black men, and 32% of black women will die.
  — At ≥70 years of age, 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 40 to 69 years of age, 16% of men and 22% of women.
  — at 40 to 69 years of age, 14% of white men, 18% of white women, 27% of black men, and 29% of black women.
  — at ≥70 years of age, 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 40 to 69 years of age, 7% of men and 12% of women.
  — at ≥70 years of age, 22% of men and 25% of women.
  — at 40 to 69 years of age, 7% of white men, 11% of white women, 11% of black men, and 14% of black women.
  — at ≥70 years of age, 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 40 to 69 years of age, 4% of men and 6% of women.
  — at ≥70 years of age, 6% of men and 11% of women.
  — at 40 to 69 years of age, 3% of white men, 5% of white women, 8% of black men, and 9% of black women.
  — at ≥70 years of age, 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 40 to 69 years of age, 1.1% of white men, 1.9% of white women, 2.5% of black men, and 1.4% of black women.
  — at ≥70 years of age, 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 60 to 69 years of age, data not available for men and 7.4 for women.
  — at 70 to 79 years of age, 7.4 for men and 10.4 for women.
  — at ≥80 years of age, 2.0 for men and 6.4 for women.

Hospital Discharges and Ambulatory Care Visits

- From 1979 to 2005, the number of inpatient discharges from short-stay hospitals with CHD as the first-listed diagnosis increased 5% to 1 828 000 (NHDS, NCHS; AHA computation).
- Data from Ambulatory Care Visits to Physician Offices, Hospital Outpatient Departments, and Emergency Departments: United States, 2001 to 2002, showed the number of visits for CHD as 12.975 million (NAMCS, NHAMCS).[30]
- Most hospitalized patients over 65 years of age are women. For MI, 28.4% of hospital stays for people 45 to 64 years of age were for women, but 63.7% of stays for those ≥85 years of age were for women. Similarly, for coronary atherosclerosis, 32.7% of stays were for women among people 45 to 64 years of age; this figure increased to 60.7%

of stays among those ≥85 years of age. For nonspecific chest pain, women were more numerous than men among patients under 65 years of age. About 54.4% were for women 45 to 64 years of age. Women constituted 73.9% of nonspecific chest pain stays among patients ≥85 years of age—higher than for any other condition examined. For AMI, one third more women than men died in the hospital: 9.3% of women died in the hospital, compared with 6.2% of men.[31]

Cost

- The estimated direct and indirect cost of CHD for 2008 is $156.4 billion.
- In 2003, $12.2 billion was paid to Medicare beneficiaries for in-hospital costs when CHD was the principal diagnosis ($12 321 per discharge for acute MI, $11 783 per discharge for coronary atherosclerosis, and $5127 per discharge for other ischemic heart disease).[32]

Operations and Procedures

- In 2005, an estimated 1 271 000 inpatient angioplasty procedures, 469 000 inpatient bypass procedures, 1 322 000 inpatient diagnostic cardiac catheterizations, 91 000 inpatient implantable defibrillators, and 180 000 pacemaker procedures were performed for inpatients in the United States (unpublished data from the NHDS 2005, NCHS; personal communication, July 2007).

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 accelerating in frequency or severity and may occur while at rest but does not result in myocardial necrosis. The discomfort may be more severe and prolonged than typical AP or may be the first time a person has AP. Unstable angina, non–ST-elevation MI, and ST-elevation MI share common pathophysiological origins related to coronary plaque progression, instability, or rupture with or without luminal thrombosis and vasospasm.)

- A conservative estimate for the number of discharges with ACS from hospitals in 2005 is 772 000. Of these, an estimated 448 000 are male and 324 000 are female. This estimate is derived by adding the first-listed inpatient hospital discharges for MI (683 000) to those for UA (89 000) (NHDS, NCHS).
- When including secondary discharge diagnoses in 2005, the corresponding numbers of inpatient hospital discharges were 1 413 000 unique hospitalizations for ACS; 820 000 are male and 593 000 are female. Of the total, 838 000 were for MI alone, and 558 000 were for UA alone (17 000 hospitalizations received both diagnoses (NHDS, 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 ECG and abnormal ("positive") elevations of myocardial biomarkers such as troponins as follows:

- ST-elevation MI
- non–ST-elevation MI
- unstable angina

The percentage of ACS or MI with ST elevation varies in different registries/databases and depends heavily on the age of patients included and the type of surveillance used. According to the National Registry of Myocardial Infarction 4 (NRMI-4), about 29% of MI patients are STEMI patients.[33] The AHA Get With The Guidelines project found that 32% of the MI patients in the CAD module are STEMI patients (AHA Get With The Guidelines Staff, personal communication, October 1, 2007). The study of the Global Registry of Acute Coronary Events (GRACE), which includes US patient populations, found that 38% of ACS patients have STEMI, whereas the second Euro Heart Survey on ACS (EHS-ACS-II) reported that about 47% of ACS patients have STEMI.[34]

- Analysis of data from the GRACE multinational observational cohort study of patients with ACS found evidence of a change in practice for both pharmacological and interventional treatments in patients with either STEMI or NSTE ACS. These changes are accompanied by significant decreases in the rates of in-hospital death, cardiogenic shock, and new MI among patients with NSTE ACS. The use of evidence-based therapies and PCI interventions increased in the STEMI population. This increase was matched with a statistically significant decrease in the rates of death, cardiogenic shock, and HF or pulmonary edema.[35]
- A study of patients with NSTE ACS treated at 350 US hospitals found that up to 25% of opportunities to provide ACC/AHA guideline–recommended care were missed in current practice. Composite guideline adherence rate was significantly associated with in-hospital mortality.[36]

Angina Pectoris

ICD-9 413; ICD-10 I20. See Table 3-2 and Chart 3-5.

Prevalence

- A study of 4 national cross-sectional health examination studies found that among Americans 40 to 74 years of age, 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.[37]

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 nonblack men are 28.3 for 65 to 74 years of age, 36.3 for 75 to 84 years of age, and 33.0 for those ≥85 years of age. For nonblack 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; for black women, the rates are 15.3, 23.6, and 35.9, respectively (CHS, NHLBI).[6]

- 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 nonblack men are 8.5 for those 45 to 54 years of age, 11.9 for those 55 to 64 years of age, and 13.7 for those 65 to 74 years of age. For nonblack 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; for black women, the rates are 20.8, 19.3, and 10.0, respectively.[6]

Mortality

A small number of deaths resulting from 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.[38]

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Table 3-1. Coronary Heart Disease

Population Group	Prevalence CHD, 2005 Age ≥20 y	Prevalence MI, 2005 Age ≥20 y	New and Recurrent MI and Fatal CHD Age ≥35 y	New and Recurrent MI Age ≥35 y	Mortality* CHD, 2004 All Ages	Mortality* MI, 2004 All Ages	Hospital Discharges, CHD, 2005 All Ages	Cost CHD, 2008
Both sexes	16 000 000 (7.3%)	8 100 000 (3.7%)	1 200 000	920 000	451 326	156 816	1 828 000	$156.4 billion
Males	8 700 000 (8.9%)	5 000 000 (5.1%)	710 000	555 000	233 538 (51.7%)†	82 909 (52.9%)†	1 117 000	...
Females	7 300 000 (6.1%)	3 000 000 (2.5%)	490 000	365 000	217 788 (48.3%)†	73 907 (47.1%)†	711 000	...
NH white males	9.4%	5.4%	650 000§	...	205 475	73 448	...	...
NH white females	6.0%	2.5%	425 000§	...	190 230	64 248	...	...
NH black males	7.1%	3.9%	65 000§	...	23 060	7811	...	...
NH black females	7.8%	3.3%	60 000§	...	23 635	8395	...	...
Mexican-American males	5.6%	3.1%	...	...	...	...	...	...
Mexican-American females	5.3%	2.1%	...	...	...	...	...	...
Hispanic or Latino‡ age ≥18 y	5.9%	...	...	...	...	...	...	...
Asian‡ age ≥18 y	3.8%	...	...	...	...	...	...	...
American Indian/ Alaska Native‡ age ≥18 y	2.5%	...	...	...	...	...	...	...

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 and include Hispanics.

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

‡NHIS, NCHS (2005)—data are weighted percentages for Americans 18 years of age and older. Estimates for American Indians/Alaska Natives are considered unreliable.

§Estimates include Hispanics and non-Hispanics. Estimates for whites include other nonblack races.

Sources: Prevalence: NHANES 1999–2004 (NCHS) and NHLBI. Total data are for Americans 20 years of age 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 (NCHS) applied to 2005 population estimates (20 years of age and older). Incidence: ARIC (1987–2004), NHLBI. Mortality: NCHS (these data represent underlying cause of death only). Hospital discharges: NHDS, NCHS (data include those inpatients discharged alive, dead, or status unknown). Cost: NHLBI; data include estimated direct and indirect costs for 2008.

Table 3-2. Angina Pectoris

Population Group	Prevalence, 2005 Age ≥20 y	Incidence of Stable AP Age ≥45 y	Hospital Discharges, 2005* All Ages
Both sexes	9 100 000 (4.1%)	500 000	44 000
Males	4 400 000 (4.4%)	320 000	18 000
Females	4 600 000 (3.9%)	180 000	25 000
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 resulting from 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 96 000 days of care for discharges with AP from short-stay hospitals in 2005.

Sources: Prevalence: NHANES 1999–2004 (NCHS) and NHLBI; percentages for racial/ethnic groups are age adjusted for Americans 20 years of age 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 (NCHS) applied to 2005 population estimates (20 years of age and older). Incidence: AP uncomplicated by an MI or with no MI (FHS 1980 to 2001–2003 of the original cohort and 1980 to 1998–2001 of the offspring cohort, NHLBI). Hospital discharges: NHDS, NCHS; data include those inpatients discharged alive, dead, or status unknown.

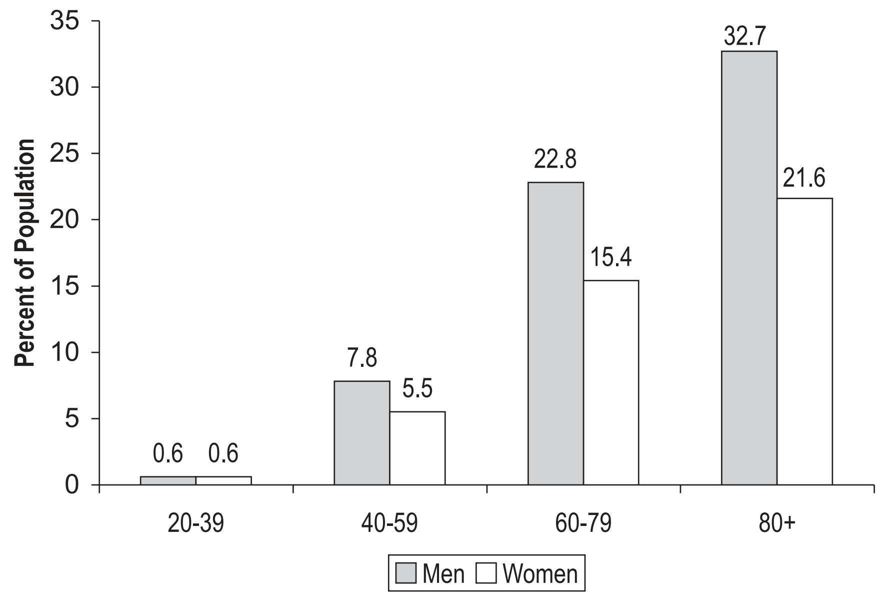


Chart 3-1. Prevalence of coronary heart disease by age and sex (NHANES: 1999–2004). Source: NCHS and NHLBI.

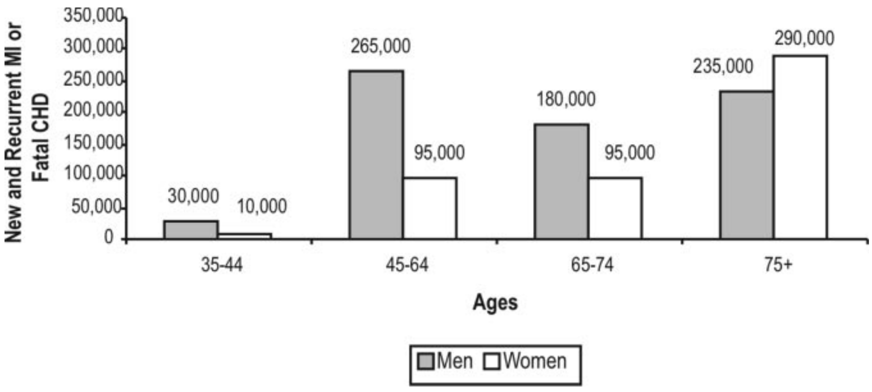


Chart 3-2. Annual number of adults having diagnosed heart attack by age and sex (ARIC: 1987–2004). Source: Personal communication with NHLBI. These data include MI and fatal CHD but not silent MI.

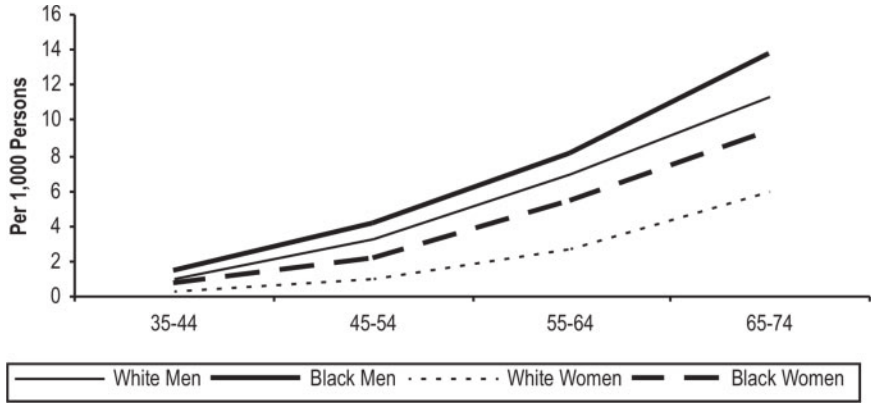


Chart 3-3. Annual rate of first heart attacks by age, sex, and race (ARIC: 1987–2004). Source: Personal communication with NHLBI.

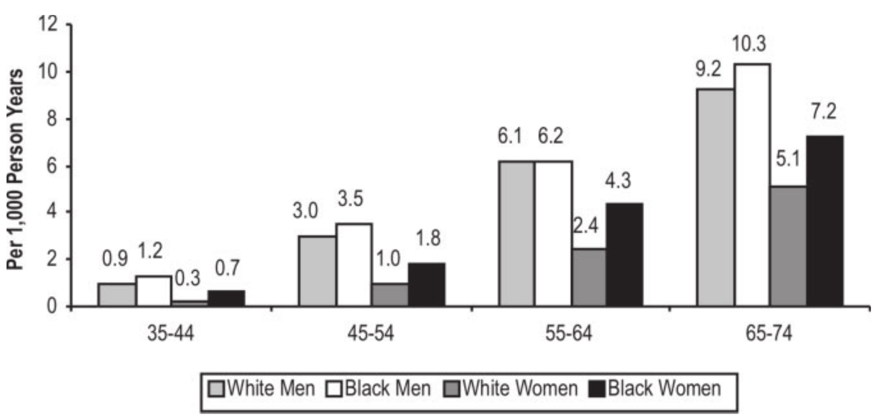


Chart 3-4. Incidence of MI* by age, race, and sex (ARIC Surveillance, 1987–2004). *MI diagnosis by expert committee based on review of hospital records. Source: Unpublished data.

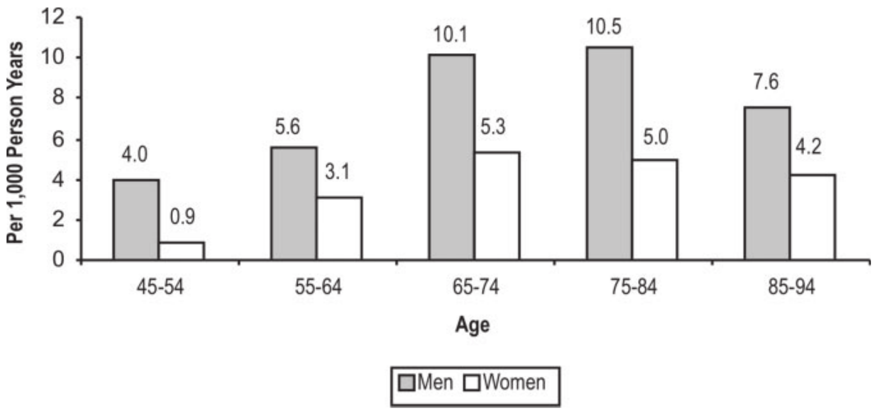
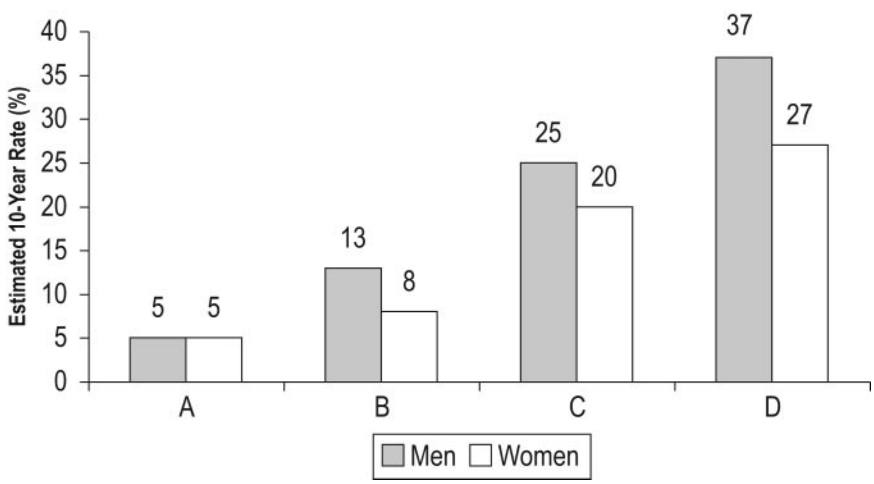


Chart 3-5. Incidence of AP* by age and sex (FHS 1980–2002/2003). *AP uncomplicated based on physician interview of patient. (Rate for women 45 to 54 years of age considered unreliable.) Source: NHLBI.[6]



	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.[39]

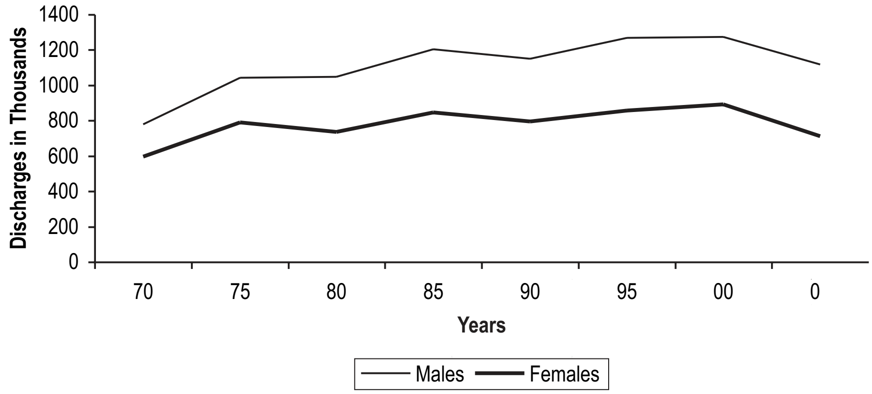


Chart 3-7. Hospital discharges for CHD by sex (United States: 1970–2005). Source: NHDS/NCHS and NHLBI. Hospital discharges include people discharged alive, dead, or "status unknown."

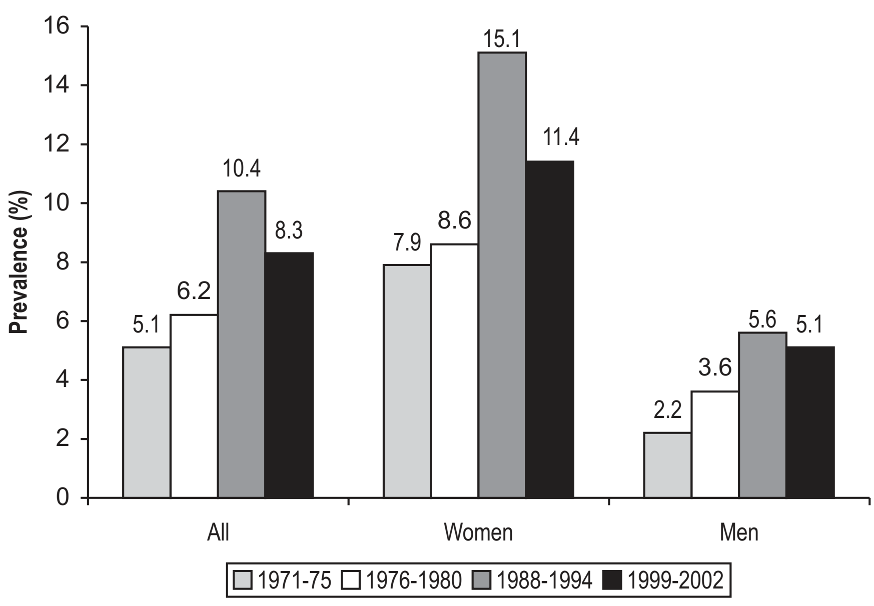


Chart 3-8. Prevalence of low CHD risk, overall and by sex among adults 25 to 74 years of age (NHANES: 1971–2002). Source: Personal communication with NHLBI, June 28, 2007. "Low risk" is defined as systolic BP <120 mm Hg and diastolic BP <80 mm Hg, cholesterol <200 mg/dL, BMI <25 kg/m^2, currently not smoking cigarettes, and no prior MI or DM.

4. Stroke

ICD-9 430-438, ICD-10 I60-I69. See Tables 4-1 and 4-2 and Charts 4-1 through 4-6.

Prevalence

- Among American Indians/Alaska Natives ≥18 years of age, it is estimated that 5.8% have had a stroke (estimate considered unreliable). Among blacks, the rate was 3.4%; among whites, it was 2.3%; and among Asians, it was 2.0% (NHIS, NCHS).[1]
- The 2005 BRFSS survey (CDC) found that many states with high stroke prevalence are concentrated in the Southeast, a region traditionally called the "stroke belt" because of its high rates of stroke mortality. However, certain states (Illinois, Michigan, Missouri, Nevada, Texas, and West Virginia) in other US regions also had prevalence estimates of 3.0% or higher, among the highest in the country. The overall prevalences of stroke among American Indians/Alaska Natives (6.0%), multiracial persons (4.6%), and blacks (4.0%) were higher than the prevalence among whites (2.3%). The prevalences of stroke among Asians/Pacific Islanders (1.6%; interpret with caution) and Hispanics (2.6%) were similar to the prevalence among whites.[2]
- The prevalence of silent cerebral infarction between 55 and 64 years of age is approximately 11%. This prevalence increases to 22% between 65 and 69 years of age, 28% between 70 and 74 years of age, 32% between 75 and 79 years of age, 40% between 80 and 85 years of age, and 43% above 85 years of age. The application of these rates to 1998 US population estimates results in an estimated 13 million people with prevalent silent stroke.[3,4]
- The prevalence of stroke in American Indian men 45 to 74 years of age 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%.[5]
- The prevalence of stroke symptoms was found to be relatively high in a general population free of a prior diagnosis of stroke or transient ischemic attack. On the basis of data from 18 462 participants enrolled in a national cohort study, 17.8% of the population over 45 years of age reported at least 1 symptom. Stroke symptoms were more likely among blacks than whites, among those with lower income and less education, and among those with fair-to-poor perceived health status. Symptoms were also more likely in participants with higher Framingham Stroke Risk Score.[6]
- According to data from the 2005 BRFSS (CDC), 2.7% of men and 2.5% of women ≥18 years of age had a history of stroke. Among these, 2.3% were non-Hispanic white, 4.0% were non-Hispanic black, 1.6% were Asian/Pacific Islander (interpret with caution), 2.6% were Hispanic (might be of any race), 6.0% were American Indian/Alaska Native, and 4.6% were multiracial (see Table 4-2).[2]

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 System
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CHS	Cardiovascular Health Study
CVD	cardiovascular disease
ED	emergency department
EPIC	European Prospective Investigation into Cancer
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
mm Hg	millimeters of mercury
NAMCS	National Ambulatory Medical Care Survey
NASCET	North American Symptomatic Carotid Endarterectomy
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
NIHSS	National Institutes of Health Stroke Scale
NINDS	National Institutes of Neurological Disorders and Stroke
NOMAS	Northern Manhattan Study
OR	odds ratio
PA	physical activity
REGARDS	REasons for Geographic And Racial Differences in Stroke study
RR	relative risk
rtPA	recombinant tissue plasminogen activator
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 mini-stroke 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]
- One third of spells characterized as TIAs according to the classic definition (focal neurological deficits that resolve

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 per 100 000. Males and blacks have higher rates of TIA.[10,11]
- Approximately half of all 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.[11,12,14,15]
- Within 1 year of TIA, up to one fourth 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, approximately 780 000 people experience a new or recurrent stroke. Approximately 600 000 of these are first attacks, and 180 000 are recurrent attacks (GCNKSS, NINDS and NHLBI; GCNKSS, NINDS data for 1999 provided August 1, 2007; US estimates compiled by NHLBI).
- On average, every 40 seconds, someone in the United States has a stroke (AHA computation based on latest available data).
- Each year, approximately 60 000 more women than men have a stroke (GCNKSS, NINDS).
- Men's stroke incidence rates are greater than women's at younger ages but not at older ages. The male/female incidence ratio (11/9) 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]
- Data from the GCNKSS, NINDS show that the annual incidence of first-ever hospitalized stroke did not change significantly between study periods: 158 per 100 000 in both 1993–1994 and 1999. Blacks continue to have a higher stroke incidence than whites, especially among the young. Despite advances in stroke prevention treatments during the 1990s, the incidence of hospitalized stroke did not decrease within the population being studied. Case fatality also did not change between study periods. Excess stroke mortality rates seen in blacks nationally are likely the result of excess stroke incidence and not case fatality, and the racial disparity in stroke incidence did not change over time.[20]
- Blacks have a risk of first-ever stroke that is almost twice that of whites. The age-adjusted stroke incidence rates in people 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, NHLBI).[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, 10% are intracerebral hemorrhage, and 3% are subarachnoid hemorrhage strokes (GCNKSS, NINDS 1999).[19]
- The Brain Attack Surveillance in Corpus Christi (BASIC, NINDS) project 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 per 10 000 in Mexican Americans and 136 per 10 000 in non-Hispanic whites. Specifically, Mexican Americans have a higher incidence of intracerebral hemorrhage and subarachnoid hemorrhage than that of non-Hispanic whites, adjusted for age, as well as a higher incidence of ischemic stroke and TIA at younger ages than non-Hispanic whites.[21]
- 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.[5]
- 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, NINDS). Among blacks, 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.[22]
- Analysis of data from the FHS study of the NHLBI, from 1950 to 1977, 1978 to 1989, and 1990 to 2004, showed that the age-adjusted incidence of first stroke per 1000 person-years in each of the 3 periods was 7.6, 6.2, and 5.3 in men and 6.2, 5.8, and 5.1 in women, respectively. Lifetime risk at the age of 65 years decreased significantly, from 19.5% to 14.5% in men and from 18.0% to 16.1% in women. Age-adjusted stroke severity did not vary across periods; however, 30-day mortality decreased significantly in men (from 23% to 14%) but not in women (from 21% to 20%).[23]

Mortality

Stroke accounted for approximately 1 of every 16 deaths in the United States in 2004. Approximately 54% of stroke deaths in 2004 occurred out of the hospital.[24]

- Stroke mortality—150 074; total-mention mortality in 2004 was approximately 253 000.[24]
- 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 (NCHS, 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.[25]
- 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 rate was 12.6% for all strokes, 8.1% for ischemic strokes, and 44.6% for hemorrhagic strokes.[26]
- From 1994 to 2004, the stroke death rate fell 24.2%, and the actual number of stroke deaths declined 6.8%.[27]
- Conclusions about changes in stroke death rates from 1983 to 2004:
  - There was a greater decline in stroke death rates in males than in females, with a male/female ratio decreasing from 1.11 to 1.03 (age-adjusted).
  - There were greater declines in stroke death rates at ≥65 years of age in men than in women compared with younger ages.[27]
- The 2004 overall death rate for stroke was 50.0 per 100 000. Death rates were 48.1 for white males, 74.9 for black males, 47.2 for white females, and 65.5 for black females.[27]
- In 2004, death rates for stroke were 41.5 for Hispanic or Latino males and 35.4 for females; 44.2 for Asian or Pacific Islander males and 38.9 for females; and 35.0 for American Indian/Alaska Native males and 35.1 for females.[28]
- 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.[29]
- 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.[30]
- 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 than 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.[31]

Stroke Risk Factors

- TIAs confer a substantial short-term risk of stroke, hospitalization for cardiovascular events, and death. Of 1707 TIA patients evaluated in the ED 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 that lasted >10 minutes.[32]
- The risk of ischemic stroke associated with cigarette smoking has been shown to be approximately double that of nonsmokers after adjustment for other risk factors (FHS, CHS, HHP, NHLBI). Atrial fibrillation (AF) is an independent risk factor for stroke, increasing risk approximately 5-fold.[33]
- In adults >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 <120/80 mm Hg have approximately half the lifetime risk of stroke of subjects with hypertension.[34]
- Ischemic stroke patients with diabetes are younger, more likely to be black, and more likely to have hypertension, MI, and high cholesterol than nondiabetic patients, according to data from the GCNKSS/NINDS 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 55 years of age in blacks and before 65 years of age in whites. One-year case fatality rates after ischemic stroke are not different between patients with and without diabetes.[35]
- A study of >37 000 women ≥45 years of age participating in the Women's Health Study suggests that a healthy lifestyle that consists of abstinence from smoking, low BMI, moderate alcohol consumption, regular exercise, and a healthy diet was associated with a significantly reduced risk of total and ischemic stroke but not of hemorrhagic stroke.[36]
- In a recent ARIC/NHLBI study of a biracial population 45 to 64 years of age, with an average follow-up of 13.4 years, researchers found that blacks had a 3-fold higher multivariate-adjusted risk ratio of lacunar stroke than whites, whereas no difference in nonlacunar strokes was found after adjustment for prevalent risk factors between these 2 groups. The top 3 risk factors based on the population-attributable fraction for lacunar stroke were hypertension (population-attributable fraction 33.9%), diabetes mellitus

(26.3%), and current smoking (22.0%). The top 3 risk factors for nonlacunar stroke were hypertension (35.3%), current smoking (11.4%), and diabetes mellitus (11.3%).[37]

- In the Women's Health Initiative trial, 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.[38]
- In the FHS of the NHLBI, in participants <65 years of age, the risk of developing stroke/TIA was 4.21 times greater in those with symptoms of depression. After adjustment for components of the Framingham Stroke Risk Profile and education, similar results were obtained. In subjects ≥65 years of age, use of antidepressant medications did not alter the risk associated with depressive symptoms. Identification of depressive symptoms at younger ages may have an impact on the primary prevention of stroke.[39]
- High BP is the biggest risk factor for stroke.[40]
- Data from the HHP/NHLBI found that in 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.[41]

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 relative risk (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 pregnancy/postpregnancy period was 8.1 per 100 000 pregnancies.[42]
- With 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 who were 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.[43]
- 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 per 100 000, not including subarachnoid hemorrhage. The risk was increased in blacks 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.[44]

Postmenopause as a Risk Factor for Stroke

- Stroke is a major health issue for women, particularly for postmenopausal women, which raises the question of whether increased incidence is due to aging or to hormone status and whether hormone therapy affects risk.[45]
- Among postmenopausal women who were generally healthy, the Women's Health Initiative, a randomized trial of 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.[46]
- 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.[47]
- 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.[48]
- Clinical trial data indicate that the use of estrogen plus progestin, as well as estrogen alone, increases stroke risk in postmenopausal, generally healthy women and provides no protection for women with established heart disease.[46,49]

Physical Inactivity as a Risk Factor for Stroke

- PA 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 per week).[50] The Harvard Alumni Study showed a decrease in total stroke risk in men who were highly physically active (RR=0.82).[51] More recently, a clear inverse relationship between stroke incidence and increasing levels of combined work and leisure activity were shown in the EPIC-Norfolk study of 22 602 men and women, with a nearly 40% risk reduction in the most active category. In sex-stratified analysis, the trend was not significant in women.[52]
- For women in the Nurses' Health Study, RRs for total stroke from the lowest to the highest PA levels were 1.00, 0.98, 0.82, 0.74, and 0.66, respectively.[53]
- NOMAS (NINDS), which included white, black, and Hispanic men and women in an urban setting, showed a decrease in ischemic stroke risk associated with PA levels across all racial/ethnic and age groups and for each gender (odds ratio [OR] 0.37).[54]
- PA— 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/NHLBI cohort.[55]

- The association between type of PA 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.[56] In a study of 47 721 men and women in Finland, the effect of leisure-time, occupational, and commuting PA on incident stroke was investigated. Significant trends toward lower stroke risk 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 was seen with occupational activity.[57] 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 PA protected against total stroke, hemorrhagic stroke, and ischemic stroke.[58]

Awareness of Stroke Warning Signs and Risk Factors

- 2001 data from the BRFSS (CDC) survey in 17 states and the US Virgin Islands showed that public awareness of the major stroke warning signs was high[59]:

  — 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.[59]
- A study was conducted of patients admitted to an ED 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 >65 years of age were less likely than those <65 years old to know a sign or symptom of stroke (28% versus 47%), 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.[60]
- A study of >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).[61,62] In the 1995 survey,[62] respondents ≥75 years of age were less likely to correctly list 1 warning sign and to list 1 risk factor.
- 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/CDC data from >61 000 adults.[63]
- Among patients recruited from the Academic Medical Center Consortium, the CHS, and United HealthCare, only 41% were aware of their increased risk for stroke. Approximately 74% recalled being told of their increased stroke risk by a physician, compared with 28% who did not recall this. 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.[64]
- An AHA-sponsored random-digit dialing telephone survey was conducted in mid-2003. Only 26% of women over 65 years of age reported being well informed about stroke. Correct identification of the warning signs of stroke was low among all racial/ethnic and age groups.[65]
- 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.[66]
- 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, and 97% required the study of cardiology. Underrepresentation of neurology in internal medicine residency programs may contribute to stroke outcome.[67]
- In 2004, 800 adults ≥45 years of age 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% of those with ≥3 risk factors did not perceive themselves to be at risk.[68]
- A telephone survey of adults ≥45 years of age in 2 Montana counties showed that >70% were able to correctly name ≥2 warning signs for stroke. More than 45% were able to name ≥2 risk factors. Respondents 45 to 64 years of age, women, those with ≥12 years of education, and those with high cholesterol were more likely to correctly identify ≥2 warning signs than were those without these characteristics. Women and respondents 45 to 64 years of age were also more likely than men or older respondents to correctly identify ≥2 stroke risk factors.[69]
- A study of patients who have had a stroke found that only 60.5% were able to accurately identify 1 stroke risk factor, and 55.3% were able to identify 1 stroke symptom. Patients' median delay time from onset of symptoms to admission in the ED was 16 hours, and only 31.6% accessed the ED in <2 hours. Analysis showed that the appearance of nonmotor

symptoms as the primary symptom and nonuse of the 9-1-1 system were significant predictors of delay >2 hours. Someone other than the patient made the decision to seek treatment in 66% of the cases.[70]

- Research confirms that first- and second-generation Hispanic adolescents and young adults continue to demonstrate increased levels of smoking, physical inactivity, and obesity. When educational material is presented in a familiar environment and offers lifestyle options that are culturally realistic, there is an increase in knowledge and compliance with lifestyle changes.[71]
- Spanish-speaking Hispanics are far less likely to know all heart attack symptoms and less likely to know all stroke symptoms than English-speaking Hispanics, non-Hispanic blacks, and non-Hispanic whites. Lack of English proficiency is strongly associated with lack of heart attack and stroke knowledge among Hispanics. This highlights the need for educational intervention about cardiovascular emergencies targeted to Spanish-speaking communities.[72]
- In the REasons for Geographic And Racial Differences in Stroke study (REGARDS), black participants were more aware than whites of their hypertension and more likely to be undergoing treatment if aware of their diagnosis, but among those treated for hypertension, they were less likely than whites to have their BP controlled. There was no evidence of a difference between the stroke belt and other regions in awareness of hypertension, but there was a trend for better treatment and control in the stroke belt region. The lack of substantial geographic differences in hypertension awareness and the trend toward better treatment and control in the stroke belt suggest that differences in hypertension management may not be a major contributor to the geographic disparity in stroke mortality.[73]

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).[74]

- The median time from stroke onset to arrival in an ED 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 strokelike 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.[75]
- Data from the Paul Coverdell National Acute Stroke Registry were analyzed from the 142 hospitals that participated in the 4 registry states. Among the >17 600 patients in the study, 66.1% were ≥65 years of age. Women were older than men, and whites were older than blacks. Ischemic stroke (65%) was the most common subtype, followed by TIA (24%) and hemorrhagic stroke (9.7%). More patients were transported by ambulance than by other means (43.6%). Time of stroke symptom onset was recorded for 44.8% of the patients. Among these patients, 48% arrived at the ED within 2 hours of symptom onset. Significantly fewer blacks (42.4%) arrived within 2 hours of symptom onset than did whites (49.5%), and significantly fewer nonambulance patients (36.2%) arrived within 2 hours of symptom onset than did patients transported by ambulance (58.6%). The median arrival time for all patients with known time of onset was 2.0 hours. Sixty-five percent of patients who arrived at the ED within 2 hours of onset received imaging within 1 hour of ED arrival. Significantly fewer women (62%) received imaging within 1 hour of ED arrival than men.[76]
- Data from the BRFSS (CDC) 2005 survey on stroke survivors in 21 states and the District of Columbia found that 30.7% of stroke survivors received outpatient rehabilitation. The findings indicated that the prevalence of stroke survivors receiving outpatient stroke rehabilitation was lower than would be expected if clinical practice guideline recommendations for all stroke patients had been followed. Increasing the number of stroke survivors who receive needed outpatient rehabilitation might lead to better functional status and quality of life in this population.[77]
- In 1999, more than 1 100 000 American adults reported difficulty with such things as functional limitations and activities of daily living as a result of stroke (SIPP).[74]
- 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.[78]
- 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[79]:

  - — 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, NHCS), as analyzed by the CDC.[80]
- Of patients with ischemic stroke in the California Acute Stroke Pilot Registry, 23.5% arrived at the ED 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.[81]
- 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 improved significantly 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.[82]
- 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 ED within 3 hours and met other eligibility criteria for treatment with recombinant tissue plasminogen activator (rtPA). Even if time were not an exclusion criterion for use of rtPA, only 29% of all ischemic strokes in the population would have otherwise been eligible for rtPA.[83]

Hospital Discharges/Ambulatory Care Visits

From 1979 to 2005, the number of inpatient discharges from short-stay hospitals with stroke as the first listed diagnosis increased 20%, to 895 000 (NHDS, NCHS; AHA computation).

- 2005 data from the Hospital Discharge Survey of the NCHS showed the average length of stay for discharges with stroke as the first-listed diagnosis was 5.2 days.[84]
- Between 1980 and 1999, hospital discharge rates for stroke increased for blacks and whites; in-hospital mortality rates decreased for both black and white patients. Generally, the risk of stroke hospitalization was more than 70% greater for blacks than for whites. Both groups were similar in terms of in-hospital mortality rates.[85] Note: Estimates by race, especially time trends, are affected by the increasing underreporting of race in the NHDS/NCHS.[86]
- In 1999–2000, the number of ambulatory care visits for stroke was 3.0 million (NAMCS, NHAMCS/NCHS).[87]
- In 2003, men and women accounted for roughly the same number of hospital stays for stroke in the 18- to 44-year-old age group. After 65 years of age, women were the majority. Among 65- to 84-year-olds, 54.5% of stroke patients were women, whereas among the oldest age group, women constituted 69.7% of all stroke patients.[88]

Cost

The estimated direct and indirect cost of stroke for 2008 is $65.5 billion.

- In 2003, $3.7 billion ($6363 per discharge) was paid to Medicare beneficiaries discharged from short-stay hospitals for stroke.[89]
- 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 use of the medical component of the Consumer Price Index.)[90]
- 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).[91]
- Inpatient hospital costs for an acute stroke event account for 70% of first-year poststroke costs.[90]
- The largest components of acute-care costs were room charges (50%), medical management (21%), and diagnostic costs (19%).[92]
- Death within 7 days, subarachnoid hemorrhage, and stroke while hospitalized for another condition are associated with higher costs in the first year. Lower costs are associated with mild cerebral infarctions or residence in a nursing home before the stroke.[91]
- Demographic variables (age, sex, and insurance status) are not associated with stroke cost. Severe strokes (NIHSS score >20) cost twice as much as mild strokes, despite similar diagnostic testing. Comorbidities such as ischemic

heart disease and AF predict higher costs.[92,93] The total cost of stroke from 2005 to 2050, in 2005 dollars, is projected to be $1.52 trillion for non-Hispanic whites, $313 billion for Hispanics, and $379 billion for blacks. The per capita cost of stroke estimates are highest in blacks ($25 782), followed by Hispanics ($17 201) and non-Hispanic whites ($15 597). Loss of earnings is expected to be the highest cost contributor in each race-ethnic group.[94]

Operations and Procedures

In 2005, an estimated 103 000 inpatient endarterectomy procedures were performed in the United States. Carotid endarterectomy is the most frequently performed surgical procedure to prevent stroke (NHDS, NCHS).

Stroke in Children

- Stroke in children peaks in the perinatal period. In the NHDS/NCHS, from 1980 to 1998, the rate of stroke for infants <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.[95]
- 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 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.[96]
- The overall incidence rate of all strokes in children under 15 years of age was 6.4 per 100 000 in 1999, a nonsignificant increase compared with 1988. The 30-day case fatality rates were 18% in 1988–1989, 9% in 1993–1994, and 9% in 1999. The incidence of stroke in children has been stable over the past 10 years. The previously reported nationwide decrease in overall stroke mortality in children might be due to decreasing case fatality after stroke and not decreasing stroke incidence. It was conservatively estimated that approximately 3000 children and adults younger than 20 years of age would have a stroke in the United States in 2004.[97]
- Stroke in childhood and young adulthood has a disproportionate impact on the affected patients, their families, and society compared with stroke at older ages. Outcome of childhood stroke was a moderate or severe deficit in 42% of cases.[98]
- 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.[99]
- Despite current treatment, 1 of 10 children with ischemic stroke will have a recurrence within 5 years.[100]
- 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 <1 year of age has remained the same over the past 40 years.[94]
- From 1979 to 1998 in the United States, childhood mortality due to stroke declined by 58% overall, with reductions in all major subtypes.[101]
  - — Ischemic stroke decreased by 19%, subarachnoid hemorrhage by 79%, and intracerebral hemorrhage by 54%.
  - — Black ethnicity was a risk factor for death due to all stroke types.
  - — Male sex was a risk factor for death due to subarachnoid hemorrhage and intracerebral hemorrhage but not for death due to ischemic stroke.
- Sickle cell disease is the most important cause of ischemic stroke among black 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 years with sickle cell disease showed a dramatic decline subsequent to the publication of the STOP study. For the study years 1991–1998, 93 children with sickle cell disease were admitted to California hospitals with a first stroke; 92.5% of these strokes were ischemic, and 7.5% were hemorrhagic. The first-stroke rate was 0.88 per 100 person-years during 1991–1998, compared with 0.50 in 1999 and 0.17 in 2000 ($P<0.005$ for trend).[102]

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Table 4-1. Stroke

Population Group	Prevalence, 2005 Age ≥20 y	New and Recurrent Attacks All Ages	Mortality, 2004 All Ages*	Hospital Discharges, 2005 All Ages	Cost, 2008
Both sexes	5 800 000 (2.6%)	780 000	150 074	895 000	$65.5 billion
Males	2 300 000 (2.6%)	360 000 (46%)†	58 800 (39.2%)†	418 000	...
Females	3 400 000 (2.8%)	420 000 (54%)†	91 274 (60.8%)†	477 000	...
NH white males	2.4%	304 000‡	49 296	...	...
NH white females	2.7%	343 000‡	78 572	...	...
NH black males	4.1%	43 000‡	7 644	...	...
NH black females	4.1%	60 000‡	10 474	...	...
Mexican-American males	3.1%	...	...	...	...
Mexican-American females	1.9%	...	...	...	...
Hispanic or Latino age ≥18 y§	2.2%	...	...	...	...
Asian age ≥18 y§	2.0%	...	...	...	...
American Indian/Alaska Native age ≥18 y§	5.8%‖	...	...	...	...

Ellipses (. . .) indicate data not available.

*Mortality data are for whites and blacks and include Hispanics.

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

‡Estimates include Hispanics and non-Hispanics. Estimates for whites include other nonblack races.

§NHIS 2005 (NCHS): data are weighted percentages for Americans 18 years of age and older.

‖Estimates are considered unreliable.

Sources: Prevalence (total, males, females, whites, blacks, Mexican Americans) is based on NHLBI computations of NHANES 1999–2004, NCHS (20 years of age and older). Age-adjusted rates are extrapolated to the US population 20 years of age and older, 2005. Prevalence data for the Hispanic, Asian, and American Indian/Alaska Native populations, 18 years of age and older, are from NHIS/NCHS.[2] Incidence: GCNKSS/NINDS data for 1999 provided on August 1, 2007. US estimates compiled by NHLBI. See also Kissela et al.[104] Data include children. Mortality: NCHS. These data represent underlying cause of death only. Mortality data for white and black males and females include Hispanics. Hospital discharges: NHDS, NCHS. Data include those inpatients discharged alive, dead, or status unknown. Cost: NHLBI. Data include estimated direct and indirect costs for 2008.

Table 4-2. Estimated Prevalence of Stroke, by State: United States, 2005

State/Area	Estimated No. of Residents With History of Stroke	Weighted, Age-Adjusted Prevalence of Stroke, %
Alabama	117 000	3.2
Alaska	8 000	2.5
Arizona	88 000	2.1
Arkansas	63 000	3.0
California	641 000	2.6
Colorado	49 000	1.7
Connecticut	45 000	1.5
Delaware	17 000	2.6
District of Columbia	14 000	3.4
Florida	432 000	2.8
Georgia	164 000	2.9
Hawaii	28 000	2.8
Idaho	24 000	2.4
Illinois	278 000	3.0
Indiana	119 000	2.5
Iowa	67 000	2.6
Kansas	49 000	2.3
Kentucky	102 000	3.1
Louisiana	91 000	3.3
Maine	27 000	2.4
Maryland	89 000	2.1
Massachusetts	111 000	2.1
Michigan	225 000	3.0
Minnesota	65 000	1.7
Mississippi	91 000	4.3
Missouri	147 000	3.1
Montana	16 000	2.1
Nebraska	31 000	2.2
Nevada	51 000	3.2
New Hampshire	26 000	2.6
New Jersey	146 000	2.1
New Mexico	31 000	2.2
New York	365 000	2.4
North Carolina	179 000	2.8
North Dakota	10 000	1.8
Ohio	207 000	2.3
Oklahoma	95 000	3.4
Oregon	72 000	2.5
Pennsylvania	237 000	2.2
Rhode Island	19 000	2.1
South Carolina	96 000	2.9
South Dakota	16 000	2.6
Tennessee	142 000	3.1
Texas	455 000	3.0
Utah	34 000	2.6
Vermont	11 000	2.1
Virginia	146 000	2.7
Washington	108 000	2.4
West Virginia	48 000	3.0
Wisconsin	81 000	1.9
Wyoming	7 000	1.9
Puerto Rico	54 000	1.9
US Virgin Islands	NA	NA
Total	5 839 000	2.6

NA indicates not available.

Source: Centers for Disease Control and Prevention.[2]

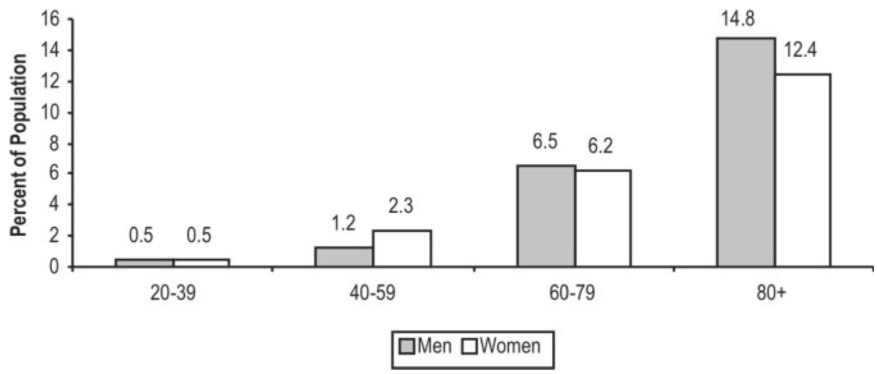


Chart 4-1. Prevalence of stroke by age and sex (NHANES: 1999–2004). Source: NCHS and NHLBI.

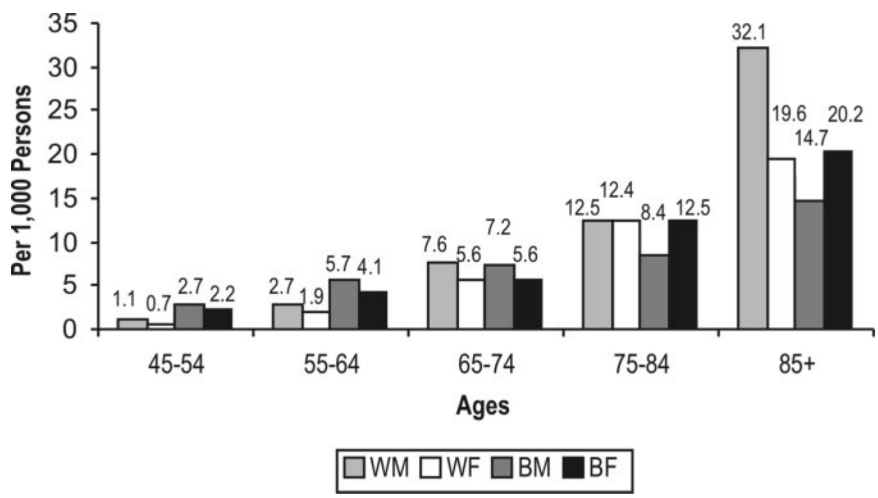


Chart 4-2. Annual rate of first cerebral infarction by age, sex, and race (GCNKSS: 1999). Rates for ages 45 to 54 years for black males and females and for black males ≥75 years of age are considered unreliable. An estimated 15 000 people have first cerebral infarctions before age 45 years. Source: unpublished data from the GCNKSS. WM indicates white males; WF, white females; BM, black males; and BF, black females.

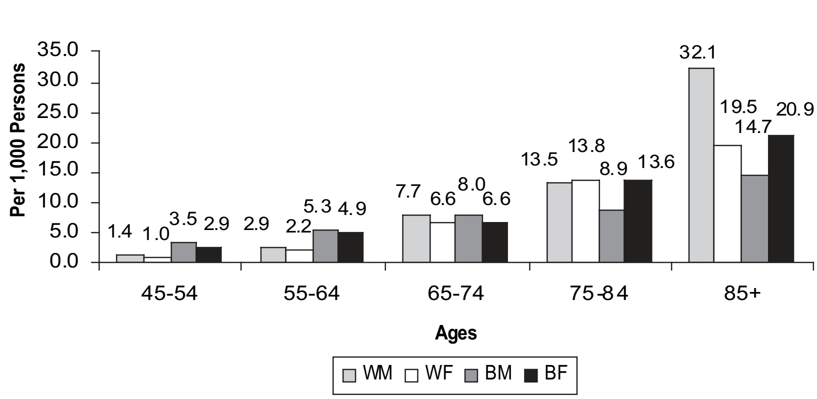
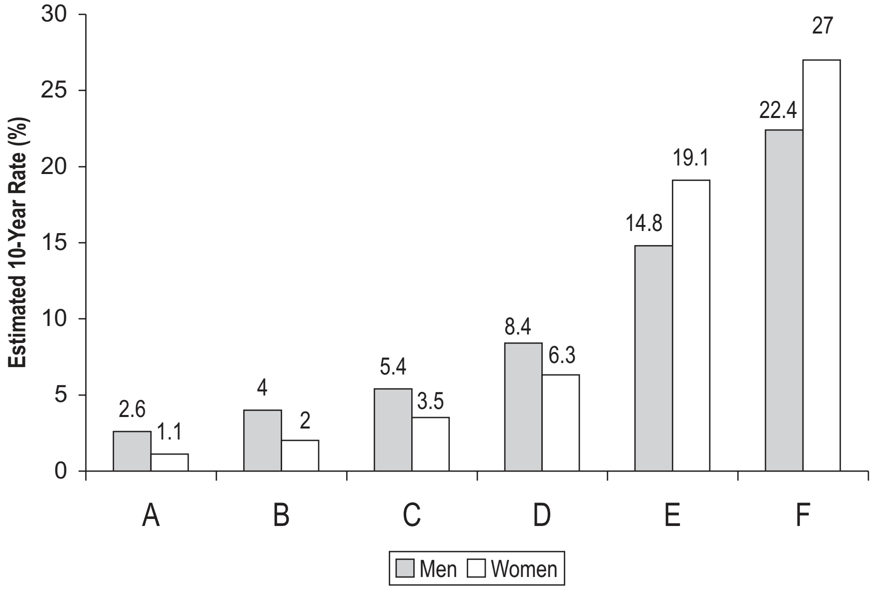


Chart 4-3. Annual rate of all first-ever strokes by age, sex, and race (GCNKSS: 1999). Rates for ages 45 to 54 years for black males and females and for black males ≥75 years of age are considered unreliable. An estimated 27 000 people have first-ever strokes before 45 years of age. Source: unpublished data from the GCNKSS. WM indicates white males; WF, white females; BM, black males; and BF, black females.



	A	B	C	D	E	F
Systolic BP*	95–105	138–148	138–148	138–148	138–148	138–148
Diabetes	No	No	Yes	Yes	Yes	Yes
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 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.[103]

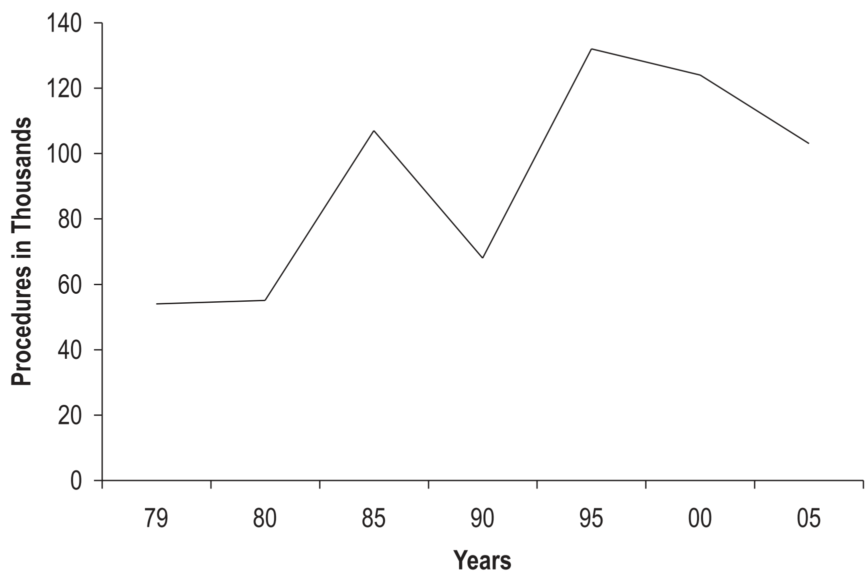


Chart 4-5. Trends in carotid endarterectomy procedures (United States: 1979–2005). Source: NHDS/NCHS and NHLBI.

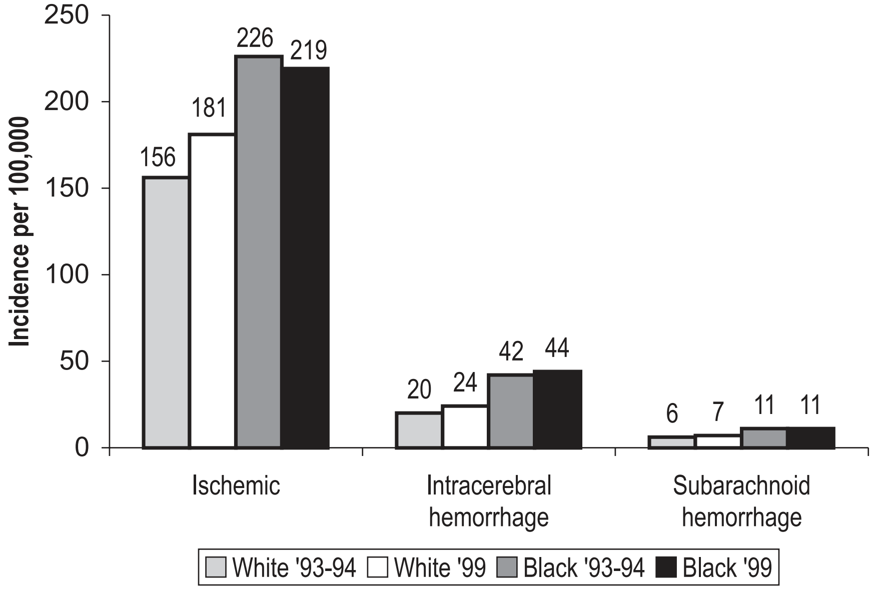


Chart 4-6. Annual age-adjusted incidence of first-ever stroke, by race. Inpatient plus out-of-hospital ascertainment, 1993–1994 and 1999. Source: Kleindorfer et al.[20]

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 ≥140 mm Hg or diastolic BP ≥90 mm Hg or taking antihypertensive medicine
  - or having been told at least twice by a physician or other health professional that one has HBP.
- One in 3 US adults has HBP.[1]
- A higher percentage of men than women have HBP until 45 years of age. From 45 to 54 years of age, the percentages of men and women with HBP are similar. After that, a much higher percentage of women have HBP than do men.[2]
- 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.[3]

Older Adults

- Age-adjusted estimates show that in 2004–2005, diagnosed chronic conditions that were more prevalent among older women than men included hypertension (51% for women, 45% for men). Ever-diagnosed conditions that were more prevalent among older men than older women included heart disease (33% for men, 26% for women) and diabetes (17% for men, 15% for women).[4]
- The age-adjusted prevalence of hypertension (both diagnosed and undiagnosed) in 1999–2002 was 78% for older women and 64% for older men on the basis of data from NHANES/NCHS.[4]

Abbreviations Used in Chapter 5

ARIC	Atherosclerosis Risk in Communities Study
BMI	body mass index
BP	blood pressure
BRFSS	Behavior Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CHF	congestive heart failure
CHS	Cardiovascular Health Study
CVD	cardiovascular disease
FHS	Framingham Heart Study
HBP	high blood pressure
HHANES	Hispanic Health and Nutrition Examination Survey
ICD	International Classification of Diseases
JNC	Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure
LDL	low-density lipoprotein
MESA	Multi-Ethnic Study of Atherosclerosis
mm Hg	millimeter of mercury
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHANES	National Health and Nutrition Examination Survey
NHES	National Health 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

Children and Adolescents

- Analysis of NHES, HHANES, and NHANES/NCHS surveys of the NCHS (1963–2002) found that the BP, pre-HBP, and HBP trends in children and adolescents 8 to 17 years of age were downward from 1963 to 1988 and upward thereafter. Pre-HBP and HBP increased 2.3% and 1%, respectively, between 1988 and 1999. Increased obesity (more so abdominal obesity than general obesity) partially explained the HBP and pre-HBP rise from 1988 to 1999. Blood pressure and HBP reversed their downward trends 10 years after the increase in the prevalence of obesity. In addition, an ethnic and gender gap appeared in 1988 for pre-HBP and in 1999 for HBP; non-Hispanic blacks and Mexican Americans had a greater prevalence of HBP and pre-HBP than non-Hispanic whites, and the prevalence was greater in males than in females. In this study, HBP in children and adolescents is defined as SBP and/or DBP that is, on repeated measurement, equal to or greater than the 95th percentile.[5]
- A study in Ohio of >14 000 children and adolescents 3 to 18 years of age observed at least 3 times between 1999 and 2006 found that 3.6% had hypertension. Of these, 26% had been diagnosed and 74% were undiagnosed. In addition, 3% of those with hypertension had stage 2 hypertension, and 41% of those with stage 2 were undiagnosed. Criteria for prehypertension were met by 485 children. Of these, 11% were diagnosed. In this study, HBP in children and adolescents is defined as systolic BP and/or diastolic BP that is, on repeated measurement, equal to or greater than the 95th percentile.[6]
- 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 by 1.6 mm Hg among girls and 2.9 mm Hg among boys compared with non-Hispanic whites. Among Mexican Americans, girls' systolic BP increased 1.0 mm Hg and boys' systolic BP increased 2.7 mm Hg compared with non-Hispanic whites.[7]

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%.[8]

- 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.[8,9]
  - — 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, to be younger, and to have infrequent contact with a physician.
- Analysis from the REGARDS study 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.[10]
- Data from the 2005 NHIS survey showed that American Indian/Alaska Native adults age ≥18 years were less likely (25.5%) than black adults (31.2%) and more likely than white adults (21.0%) and Asian adults (19.4%) to have been told on ≥2 occasions that they had hypertension.[11]
- The CDC analyzed death certificate data from 1995 to 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); Cuban Americans had the lowest (82.5).[12]
- Some studies suggest that Hispanic Americans have rates of HBP similar to or lower than those of non-Hispanic white Americans. Findings from a new analysis of combined data from the NHIS surveys of 2000 to 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 also was 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.[13] Data from the NHLBI's ARIC study found that hypertension was a particularly powerful risk factor for CHD in black persons, especially in black women.[14]
- Data from the Multi-Ethnic Study of Atherosclerosis (MESA) found that being born outside the United States, speaking a language other than English at home, and living fewer years in the United States were associated with a decreased prevalence of hypertension.[15]

Mortality

HBP mortality—54 707. Total-mention mortality in 2004 was about 300 000.

- From 1994 to 2004, the death rate from HBP increased 26.6%, and the actual number of deaths rose 56.1% (NCHS and NHLBI; 1994 rate modified by appropriate comparability ratio).
- The 2004 overall death rate from HBP was 18.1. Death rates were 15.7 for white males, 51.0 for black males, 14.5 for white females, and 40.9 for black females.[16]

Risk Factors

- Numerous risk factors and markers for development of hypertension have been identified, including age, ethnicity, family history of hypertension and genetic factors, lower education and socioeconomic status, greater weight, lower physical activity, psychosocial stressors, sleep apnea, and dietary factors (including dietary fats, higher sodium intake, lower potassium intake, and excessive alcohol intake) (personal communication with Donald Lloyd-Jones, July 30, 2007).
- A study of related individuals in the NHLBI's FHS estimated that when measured at a single examination, BP levels are approximately 40% heritable; when measured across multiple examinations, long-term BP trends are approximately 55% heritable.[17]

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).
- Data from FHS/NHLBI 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.[18]
- Data from the FHS/NHLBI indicate that hypertension is associated with shorter overall life expectancy, shorter life expectancy free of CVD, and more years lived with CVD.[19]

— Total life expectancy was 5.1 years longer for normotensive men and 4.9 years longer for normotensive women than for hypertensives of the same sex at 50 years of age.

— Compared with hypertensive men at 50 years of age, 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 Discharges/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.[20]

- In 2005, there were 301 000 hospitalizations with a first-listed diagnosis of essential hypertension (ICD-9–CM code 401), but essential hypertension was listed as either a primary or secondary diagnosis 9 003 000 times for hospitalized inpatients.[21]

Awareness, Treatment, and Control

- Data from NHANES/NCHS 1999–2004 showed that of those with hypertension ≥18 years of age, 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).
- Analysis of NHANES/NCHS data from 1999–2004 found that there were no significant increases in the overall prevalence, awareness, and treatment rates of hypertension. The control rates increased significantly in both sexes, non-Hispanic blacks, and Mexican Americans. Among the group ≥60 years of age, the awareness, treatment, and control rates of hypertension had all increased significantly.[22]
- Data from the 2005 BRFSS/CDC survey indicate that overall 25.5% of adults ≥18 years of age had been told that they had HBP. The highest percentage was in Mississippi (33.3%), and the lowest was in Utah (18.4%).[23]
- In NHANES/NCHS 2003–2004, rates of control were lower in Mexican Americans (26.5%) than in non-Hispanic whites (35.4%) and non-Hispanic blacks (28.9%).[22]
- The awareness, treatment, and control of HBP among those ≥65 years of age in the CHS/NHLBI 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 <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%.[24]
- Data from the FHS study of the NHLBI show that:

  — Among those ≥80 years of age, 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 <60, 60 to 79, and ≥80 years of age were 38%, 36%, and 38%, respectively; for women in the same age groups, they were 38%, 28%, and 23%, respectively.[25]

- Data from the Women's Health Initiative Observational 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 50 and 59 years of age to 41% of women between 60 and 69 years of age and 53% of women between 70 and 79 years of age, treatment rates were similar across age groups, being 64%, 65%, and 63%, respectively. Despite 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 mm Hg, compared with 41% and 37% of those 50 to 59 and 60 to 69 years of age, respectively.[26]
- A study of >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.[27]
- In 2005, a survey of people in 20 states conducted by the BRFSS of the CDC found that 19.4% of respondents on ≥2 visits to a health professional had been told they had HBP. Of these, 70.9% reported changing their eating habits; 79.5% reduced the use of or are not using salt; 79.2% reduced the use of or eliminated alcohol; 68.8% are exercising; and 73.4% are taking antihypertensive medication.[28]

Cost

- The estimated direct and indirect cost of HBP for 2008 is $69.4 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 has prehypertension, including 41 900 000 men and 27 800 000 women.[29]
- Follow-up of 9845 men and women in the FHS/NHLBI 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 of 120 to 129 mm Hg or diastolic BP of 80 to 84 mm Hg, and 37.3% for those with systolic BP of 130 to 139 mm Hg or diastolic BP of 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.[30]

- Data from FHS/NHLBI 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 under 60, between 60 and 79, and ≥80 years of age. Absolute risks for major CVD associated with prehypertension increased markedly with age: 6-year event rates for major CVD were 1.5% in prehypertensives under 60 years of age, 4.9% in those 60 to 79 years of age, and 19.8% in those ≥80 years of age.[25]
- In a study of NHANES 1999–2000 (NCHS), people with prehypertension were more likely than those with normal BP levels to have above-normal cholesterol levels, overweight/obesity, and diabetes mellitus, whereas the probability of currently smoking was lower. Persons with prehypertension were 1.65 times more likely to have at least 1 of these adverse risk factors than were those with normal blood pressure.[31]

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Table 5-1. High Blood Pressure

Population Group	Prevalence, 2005 Age ≥20 y	Mortality,* 2004 All Ages	Hospital Discharges, 2005 All Ages	Estimated Cost, 2008
Both sexes	73 000 000 (33.6%)	54 707	499 000	$69.4 billion
Males	34 000 000 (33.2%)	23 099 (42.2%)†	215 000	...
Females	39 000 000 (33.6%)	31 608 (57.8%)†	284 000	...
NH white males	32.5%	16 704	...	...
NH white females	31.9%	24 216	...	...
NH black males	42.6%	5762	...	...
NH black females	46.6%	6664	...	...
Mexican-American males	28.7%	...	...	...
Mexican-American females	31.4%	...	...	...
Hispanic or Latino‡ age ≥18 y	20.3%	...	...	...
Asian‡ age ≥18 y	19.4%	...	...	...
American Indians/Alaska Natives‡ age ≥18 y	25.5%	...	...	...

Ellipses (...) indicate data not available.

*Mortality data are for whites and blacks and include Hispanics.

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

‡NHIS (2005), NCHS; data are weighted percentages for Americans age 18 and older.

Sources: Prevalence: NHANES (1999–2004, NCHS) and NHLBI; percentages for racial/ethnic groups are age adjusted for Americans 20 years of age and older. Estimates from NHANES 1999–2004 (NCHS) applied to 2005 population estimates 20 years of age and older. Mortality: NCHS. These data represent underlying cause of death only. Hospital discharges: NHDS, NCHS; data include those discharged alive, dead, or status unknown. Cost: NHLBI; data include estimated direct and indirect costs for 2008.

Note: Hypertension is defined as systolic BP ≥140 mm Hg or diastolic BP ≥90 mm Hg, taking antihypertensive medication, or being told twice by a physician or other professional that one has hypertension. The NHLBI computed the numbers and rates on the basis of NHANES 1999–2004 (NCHS). Many studies define hypertension as BP of ≥140/90 mm Hg or taking antihypertensive medication. Under this definition, extrapolation of NHANES 1999–2004 (NCHS) data to the US population in 2005 gives an estimated prevalence of 64.4 million. That is 30% of the population ≥20 years of age compared with 34% according to the more complete definition—a difference of 9 million persons.

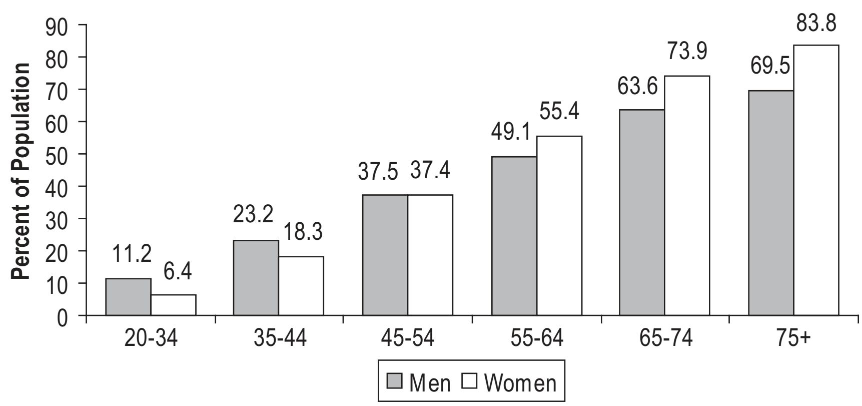

Chart 5-1. Prevalence of HBP in adults age ≥20 years by age and sex (NHANES: 1999–2004). Source: NCHS and NHLBI.

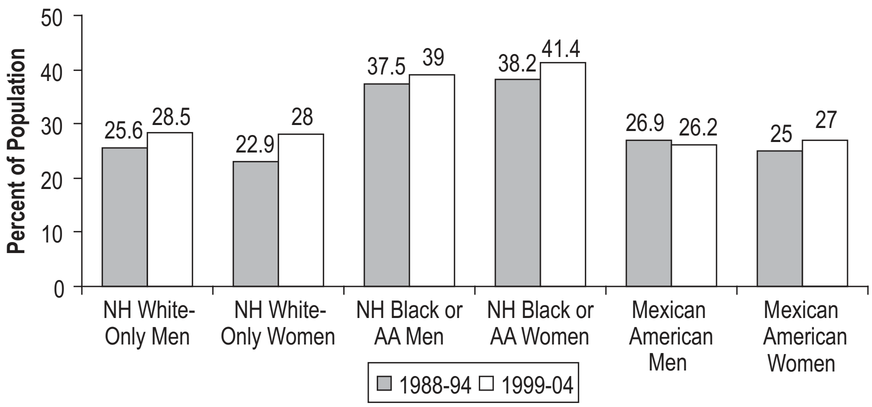

Chart 5-2. Age-adjusted prevalence trends for HBP in adults age ≥20 years by race/ethnicity, sex, and survey (NHANES: 1988–1994 and 1999–2004). Source: NCHS and NHLBI. NH indicates non-Hispanic; AA, African American.

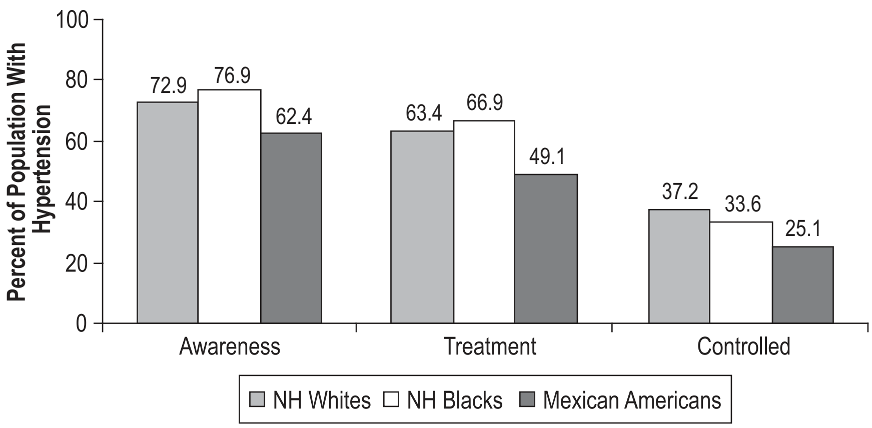

Chart 5-3. Extent of awareness, treatment, and control of HBP by race/ethnicity (NHANES: 1999–2004). Source: NCHS and NHLBI.

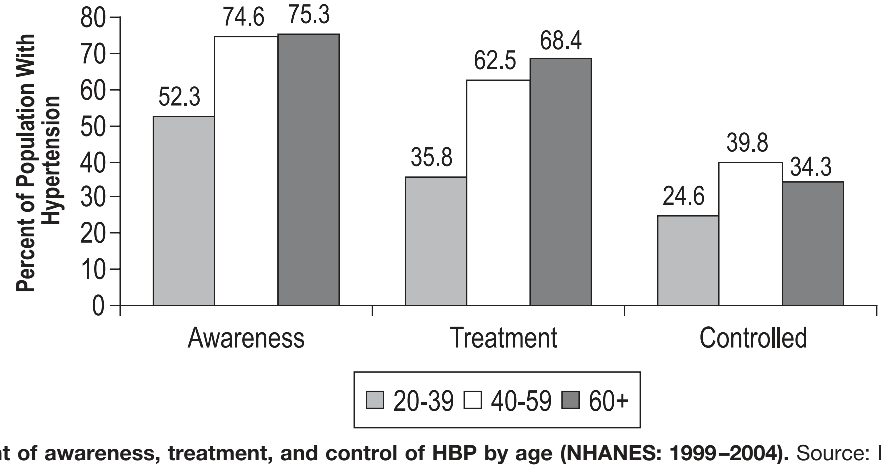

Chart 5-4. Extent of awareness, treatment, and control of HBP by age (NHANES: 1999–2004). Source: NCHS and NHLBI.

6. Congenital Cardiovascular Defects

ICD-9 745–747, ICD-10 Q20–Q28. See Tables 6-1 through 6-4.

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, which 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)

VSD is 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 <25 years of age as are 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 the 1.3 million defects, 750 000 are simple lesions, 400 000 are of moderate complexity, and 180 000 are complex. An estimated 3 million more people have 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 approximately 1 million persons with congenital heart disease. The most common types are VSD, 199 000 people; atrial septal defect (ASD), 187 000 people; patent ductus arteriosus, 144 000 people; and valvular pulmonary stenosis, 134 000 people.[2]

Abbreviations Used in Chapter 6

ASD	atrial septal defect
CDC	Centers for Disease Control and Prevention
ICD	International Classification of Diseases
KID	Kids' Inpatient Database
NCHS	National Center for Health Statistics
NHDS	National Hospital Discharge Survey
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 for 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 is 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 >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

Cardiovascular defects mortality—3861. Total-mention mortality in 2004 was 5810.

- Congenital cardiovascular defects are the most common cause of infant death from birth defects; >29% of infants who die from a birth defect have a heart defect (National Vital Statistics System, Final Data for 2004).
- The 2004 overall death rate for congenital cardiovascular defects was 1.3. Death rates were 1.4 for white males, 1.8 for black males, 1.2 for white females, and 1.4 for black females. Crude infant death rates (<1 year of age) were 38.3 for white infants and 56.0 for black infants.[10]
- In 2004, 195 000 life-years were lost before the age of 55 years because of deaths from congenital cardiovascular

defects. This is more than the life-years lost from leukemia, prostate cancer, and Alzheimer's disease combined.[11]

- The mortality rate 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. Nevertheless, 43% of deaths still occurred in infants <1 year of age. Mortality rate varies considerably according to type of defect.[12]
- From 1994 to 2004, death rates for congenital cardiovascular defects declined 31.6%, whereas the actual number of deaths declined 25.4%.

Hospitalizations

In 2004, birth defects accounted for >139 000 hospitalizations, representing 47.4 stays per 100 000 persons. Cardiac and circulatory congenital anomalies, which include ASDs and VSDs, accounted for more than one third of all hospital stays for birth defects and had the highest in-hospital mortality rate. Between 1997 and 2004, hospitalization rates increased by 28.5% for cardiac and circulatory congenital anomalies. For almost 86 300 hospitalizations, ASD was noted as the principal reason for the hospital stay or as a coexisting or secondary condition.[13]

Cost

- On the basis of 2003 data from the Healthcare Cost and Utilization Project 2003 Kids' Inpatient Database (KID) and 35 birth defects from the 45 defect categories included in the Congenital Malformations Surveillance Report, it was found that the most expensive average neonatal hospital charges were for 2 congenital heart defects: hypoplastic left heart ($199 597) and common truncus arteriosus ($192 781). Two other cardiac defects, coarctation of the aorta and transposition of the great arteries, were associated with average hospital charges in excess of $150 000. For the 11 selected cardiovascular congenital defects, there were 11 578 hospitalizations in 2003 and 1550 in-hospital deaths (13.4%). Estimated total hospital charges for these 11 conditions were $1.4 billion.[14]
- In 2004, hospital costs for congenital cardiovascular defects conditions totaled $2.6 billion. The highest aggregate costs were for stays related to cardiac and circulatory congenital anomalies, which accounted for approximately $1.4 billion—more than half of all hospital costs for birth defects.[13]

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Table 6-1. Congenital Cardiovascular Defects

Population Group	Estimated Prevalence All Ages	Incidence in Infants	Mortality, 2004 All Ages	Hospital Discharges, 2005 All Ages
Both sexes	650 000 to 1.3 million[2]	36 000[4]	3861	59 000
Males	...	...	2087 (54.1%)*	29 000
Females	...	...	1774 (45.9%)*	30 000
White males	...	...	1640	...
White females	...	...	1422	...
Black males	...	...	364	...
Black females	...	...	293	...

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[4–8]

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 <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
ASD	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. 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, >25 000 cardiovascular operations for congenital cardiovascular defects were performed on children <20 years of age. Inpatient mortality rate after all types of cardiac surgery was 4.8%. Nevertheless, mortality risk varies substantially for different defect types, from 0.4% for ASD 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%).

Source: Analysis of 2003 Kids' Inpatient Database (KID), HCUPnet, Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality (http://www.hcup-us.ahrq.gov) and personal communication with Kathy Jenkins, MD, Children's Hospital of Boston, October 1, 2006.

7. Heart Failure

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

Incidence

- Data from the NHLBI's FHS[1] indicate that:
  - — HF incidence approaches 10 per 1000 population after 65 years of age.
  - — Seventy-five percent of HF cases have antecedent hypertension.
  - — At 40 years of age, the lifetime risk of developing HF for both men and women is 1 in 5.
  - — At 40 years of age, the lifetime risk of HF occurring without antecedent MI is 1 in 9 for men and 1 in 6 for women.
  - — The lifetime risk for people with BP >160/90 mm Hg is double that of those with BP <140/90 mm Hg.
- The annual rates per 1000 population of new HF events for white men are 15.2 for those between 65 and 74 years of age, 31.7 for those between 75 and 84 years of age, and 65.2 for those ≥85 years of age. 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).[2]
- In Olmsted County, Minn, the incidence of HF (ICD-9 428) has not declined during 2 decades, but survival improved overall, with less improvement, however, among women and elderly persons.[3]

Risk Factors

- In the FHS (NHLBI), hypertension is a common risk factor for HF that contributed to a large proportion of HF cases.[4]
- Among women with CHD, diabetes was the strongest risk factor for HF. Diabetic women with elevated BMI or reduced 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 of HF was 0.4%. HF incidence increases with each additional risk factor, and nondiabetic women with ≥3 risk factors had an annual incidence of 3.4%. Among diabetic persons with no additional risk factors, the annual incidence of HF was 3.0%, compared with 8.2% among diabetics with ≥3 additional risk factors.[5]
- The prevalence of diabetes is increasing among older persons with HF, and diabetes is a risk factor for death in these individuals. Mayo Clinic data indicate 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. The 5-year survival rate was 46% for those with HF alone but only 37% for those with HF and diabetes mellitus.[6]

Left Ventricular Function

- Data from Olmsted County, Minn, indicate that:
  - — Among asymptomatic individuals, 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 (EF). The prevalence of systolic dysfunction was 6%. 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 death.[7]
  - — Among individuals with symptomatic HF, the prevalence of left ventricular diastolic dysfunction was 6% for mild diastolic dysfunction and 75% for moderate or severe diastolic dysfunction. Isolated diastolic dysfunction (diastolic dysfunction with preserved EF) was present in 44% of persons presenting with HF. The prevalence of systolic dysfunction was 45%.[8]
  - — The proportion of persons with HF and preserved EF increased over time. Survival improved over time among individuals with reduced EF but not among those with preserved EF.[9]

Mortality

In 2004, HF total-mention mortality was 284 365. HF was mentioned on 284 365 US death certificates and was selected as the "underlying cause" in 57 120 of those deaths.[10] Unlike other cardiovascular diseases, HF is the end stage of a cardiac disease. It is most often a consequence of hypertension, CHD, valve deformity, diabetes, or cardiomyopathy. There are other less common causes of HF as well. For each of the 57 120 deaths, the true underlying cause—ie, the "etiology" of HF—is not known. The certifier of the cause of death either failed to report the underlying cause or had insufficient information to do so. In those cases, HF must be nominally coded as the underlying cause. Table 7-1 contains the total-mention numbers of deaths

*Unreliable estimate.

Abbreviations Used in Chapter 7

BMI	body mass index
BP	blood pressure
CHD	coronary heart disease
CHS	Cardiovascular Health Study
EF	ejection fraction
FHS	Framingham Heart Study
HF	heart failure
ICD	International Classification of Diseases
MI	myocardial infarction
mm Hg	millimeters of mercury
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

from HF, with a footnote giving the numbers of these deaths that are coded to HF as the "underlying cause."

- The 2004 overall total-mention death rate for HF was 52.0. Total-mention death rates were 63.2 for white males, 78.8 for black males, 43.5 for white females, and 58.7 for black females (NCHS, NHLBI).
- One in 8 deaths has HF mentioned on the death certificates (NCHS, NHLBI).
- The number of total-mention deaths from HF was as high in 1994 (284 087) as it was in 2004 (NCHS, NHLBI).
- On the basis of the 44-year follow-up of the original FHS cohort (NHLBI) and 20-year follow-up of the offspring cohort:
  - Eighty percent of men and 70% of women <65 years of age who have HF will die within 8 years.
  - After HF is diagnosed, survival rate is lower 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.[11]

Hospital Discharges

- Hospital discharges for HF rose from 400 000 in 1979 to 1 084 000 in 2005, an increase of 171% (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 HF was 3.4 million.[12]

Cost

- The estimated direct and indirect cost of HF in the United States for 2008 is $34.8 billion. (See Chapter 19.) In 2003, $4.4 billion ($6577 per discharge) was paid to Medicare beneficiaries for HF.[13]

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Table 7-1. Heart Failure

Population Group	Prevalence, 2005 Age ≥20 y	Incidence (New Cases) Age ≥45 y	Mortality (Total Mentions), 2004 All Ages*	Hospital Discharges, 2005 All Ages	Cost, 2008
Both sexes	5 300 000 (2.5%)	660 000	284 365	1 084 000	$34.8 billion
Males	2 700 000 (2.8%)	...	122 749 (43.2%)†	494 000	...
Females	2 700 000 (2.2%)	...	161 616 (56.8%)†	590 000	...
NH white males	2.8%	...	109 929	...	...
NH white females	2.1%	...	144 983	...	...
NH black males	2.7%	...	10 694	...	...
NH black females	3.3%	...	14 250	...	...
Mexican-American males	2.1%	...	...	...	...
Mexican-American females	1.9%	...	...	...	...

Ellipses (...) indicate data not available.

*Mortality data are for whites and blacks and include Hispanics.

†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 ≥20 years of age. These data are based on self-reports. Estimates from NHANES 1999–2004 applied to 2005 population estimates ≥20 years of age. Incidence: FHS, 1980–2003 from NHLBI Incidence and Prevalence Chart Book, 2006. Mortality: NCHS. HF as an underlying cause of death accounted for 57 120 of the total-mention deaths in 2004: 22 292 males and 34 828 females. Hospital discharges: NHDS, NCHS; data include those inpatients discharged alive, dead, or "status unknown." Cost: NHLBI; data include estimated direct and indirect costs for 2008.

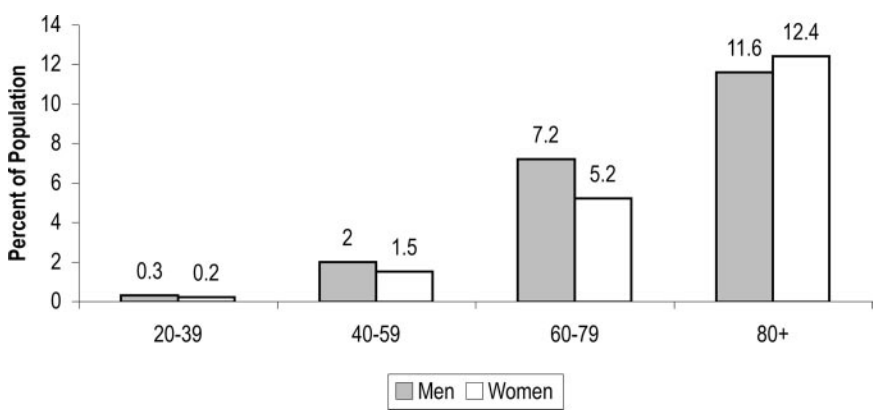

Chart 7-1. Prevalence of HF by sex and age (NHANES: 1999–2004). Sources: NCHS and NHLBI.

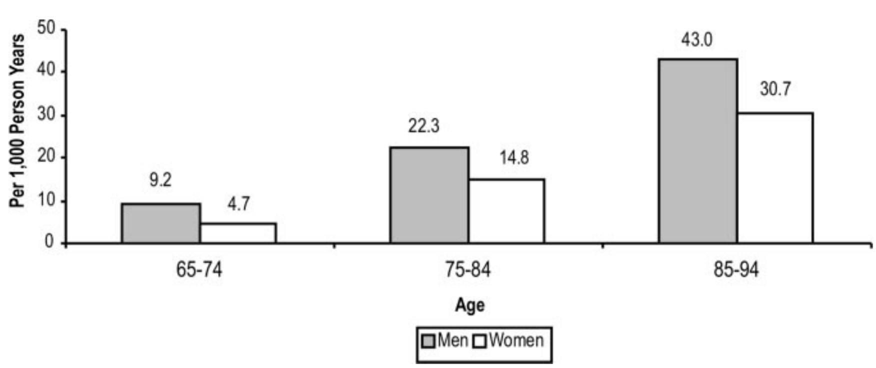

Chart 7-2. Incidence of HF (based on physician review of medical records and strict diagnostic criteria) by age and sex (FHS 1980–2003). Source: NHLBI.

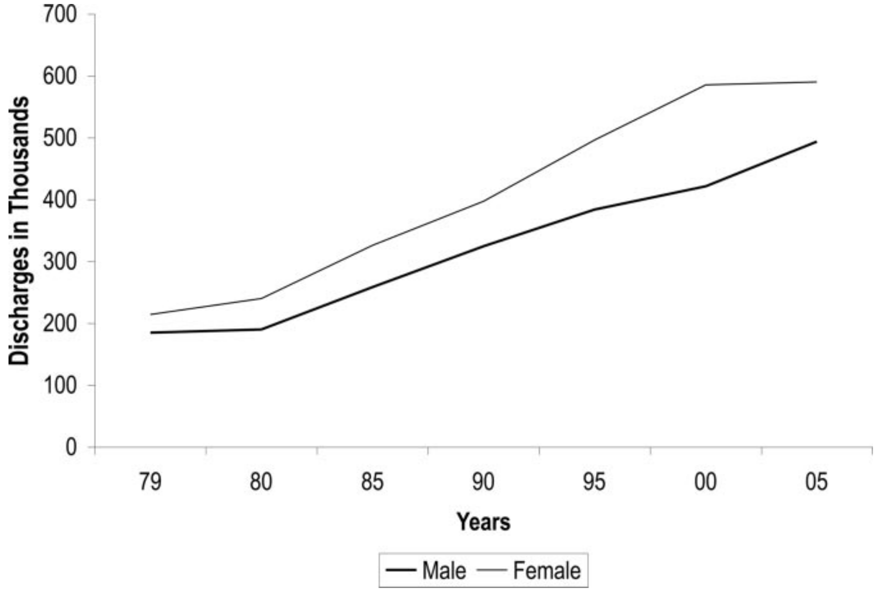

Chart 7-3. Hospital discharges for HF by sex (United States: 1979– 2005). Note: Hospital discharges include people discharged alive, dead, and "status unkown." Sources: NHDS, NCHS, and NHLBI.

8. Other Cardiovascular Diseases

See Table 8-1.

Mortality and total mentions in this section are for 2004. "Mortality" is the number of deaths in 2004 for the given underlying cause. Prevalence data are for 2005. Hospital discharge data are from the NHDS/NCHS; data include inpatients discharged alive, dead, or status unknown. Hospital discharge data for 2005 are based on ICD-9 codes.

Arrhythmias (Disorders of Heart Rhythm)

ICD-9 426, 427; ICD-10 I46-I49.

Mortality—37 001. Total-mention mortality—458 800. Hospital discharges—829 000.

In 2003, $3.1 billion ($7312 per discharge) was paid to Medicare beneficiaries for cardiac dysrhythmias.[1,2]

Atrial Fibrillation and Flutter

ICD-9 427.3; ICD-10 I48.

Mortality—10 610. Total-mention mortality—80 770. Prevalence—>2 200 000.[3] Incidence—>75 000.[4] Hospital discharges—454 000.

Abbreviations Used in Chapter 8

AAA	abdominal aortic aneurysm
AF	atrial fibrillation
ARIC	Atherosclerosis Risk in Communities study
BMI	body mass index
CAD	coronary artery disease
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CHS	Cardiovascular Health Study
cm	centimeter
CVD	cardiovascular disease
DVT	deep vein thrombosis
FHS	Framingham Heart Study
HBP	high blood pressure
HF	heart failure
ICD	International Classification of Diseases
IE	infective endocarditis
KD	Kawasaki disease
KID	Kids' Inpatient Database
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
REACH	Reduction of Atherothrombosis for Continued Health
RR	relative risk
VTE	venous thromboembolism
WHO	World Health Organization

- Participants in the FHS study of the NHLBI were followed up from 1968 to 1999. At 40 years of age, remaining lifetime risks for AF were 26.0% for men and 23.0% for women. At 80 years of age, 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 HF or MI, lifetime risk for AF was approximately 16%.[5]
- Data from a large community-based population suggest that AF is less prevalent in blacks than in whites, both overall and in the setting of CHF.[3,6]
- Data from the NHDS/NCHS (1996–2001) on cases that included AF as a primary discharge diagnosis found that[7]:
  - — Approximately 44.8% of patients were men.
  - — The mean age for men was 66.8 years, versus 74.6 years for women.
  - — The racial breakdown for admissions was 71.2% white, 5.6% black, and 2.0% other races (20.8% were not specified).
  - — Black 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 15 and 44 years of age to 1077.39/100 000 persons per year for patients ≥85 years of age. In women, the incidence ranged from 6.64/100 000 persons per year for patients between 15 and 44 years of age to 1203.7/100 000 persons per year for those ≥85 years of age.
  - — 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).[8]
- 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 HF (11.8%), followed by AF (10.9%), CHD (9.9%), and stroke (4.9%).[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.[3]
- 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]
- In Olmsted County, Minn, the age-adjusted incidence of AF increased by 12.6% between 1980 and 2000.[12,13]
  - — The incidence of AF was greater in men (incidence ratio for men over women, 1.86) and increased markedly with age.[12]
  - — According to US population projections by the Census Bureau, the projected number of persons with AF may exceed 10 million by 2050.[12]

- 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 similar to that for AF.[15]
- A study of >4600 patients diagnosed with first AF showed that mortality within the first 4 months was high. The most common causes of CVD death were CAD, HF, and ischemic stroke, accounting for 22%, 14%, and 10% respectively, of the early deaths (within the first 4 months) and 15%, 16%, and 7%, respectively, of the late deaths.[13]
- Among Medicare patients ≥65 years of age, AF prevalence increased from 3.2% in 1992 to 6.0% in 2002, with higher prevalence in older subsets of the study population. Stroke rates per 1000 patient-years declined from 46.7 in 1992 to 19.5 in 2002 for ischemic stroke but remained fairly steady for hemorrhagic stroke (1.6 to 2.9).[16]

Other Arrhythmias

Tachycardia
ICD-9 427.0, 1, 2; ICD-10 I47.0, 1, 2, 9.

Mortality—587. Total-mention mortality—6400. Hospital discharges—87 000.

Paroxysmal Supraventricular Tachycardia
ICD-9 427.0; ICD-10 I47.1.

Mortality—141. Total-mention mortality—1341. Hospital discharges—28 000.

Ventricular Fibrillation
ICD-9 427.4; ICD-10 I49.0.

Mortality—1166. Total-mention mortality—11 100. Hospital discharges—8000.

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 to 448; ICD-10 I70-I79. Includes peripheral arterial disease (PAD).

Mortality—35 554. Total-mention mortality—104 700. Hospital discharges—286 000.

Aortic Aneurysm
ICD-9 441; ICD-10 I71.

Mortality—13 753. Total-mention mortality—19 300. Hospital discharges—63 000.

- 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.[17]
- 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.[17]
- Factors associated with increased prevalence of AAA include older age, male sex, family history of AAA, tobacco use, hypertension, dyslipidemia, and manifest atherosclerotic disease in other vascular beds.[17]
- Large AAAs tend to expand more rapidly than small AAAs, and large AAAs are at substantially higher risk for rupture.[17]
  - — 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 >50% for AAAs >7.0 cm in diameter.
  - — Rupture of an AAA may be associated with death rates as high as 90%.

Atherosclerosis

ICD-9 440; ICD-10 I70.

Mortality—11 861. Total-mention mortality—75 400. Hospital discharges—126 000.

Atherosclerosis is a process that leads to a group of diseases characterized by a thickening of artery walls. Atherosclerosis causes many deaths from heart attack and stroke and accounts for nearly three fourths of all deaths from CVD (FHS, NHLBI).

Analysis of data from the REACH Registry[19] showed that atherothrombosis (CAD, CVD, and PAD) is associated with the main causes of death on a worldwide scale. Despite decreases in age-adjusted death rates, the absolute number of deaths from these conditions continues to increase, and prevalence is increasing sharply in other parts of the world. Atherothrombotic diseases are currently and are projected to be the leading cause of death worldwide by 2020. In the REACH study, outpatients with established atherosclerotic arterial disease, or at risk of atherothrombosis, experienced relatively high annual cardiovascular event rates. Multiple disease locations increased the 1-year risk of cardiovascular events.[18]

Other Diseases of Arteries
ICD-9 442 to 448; ICD-10 I72-I78.

Mortality—9940. Total-mention mortality—32 566. Hospital discharges—97 000.

Kawasaki Disease
ICD-9 446.1; ICD-10 M30.3.

Mortality—8. Total-mention mortality—12. Hospital discharges—9000, primary plus secondary diagnoses.

An estimated 5300 cases of Kawasaki disease (KD) were diagnosed in 2003. KD occurs more often among boys (63%) and among those of Asian ancestry[19] (personal communication with Jane W. Newburger and Kimberlee Gauvreau of Children's Hospital of Boston, August 15, 2007).

- An estimated 4248 hospitalizations for KD occurred in the United States in 2000, with a median patient age of 2 years. Race-specific incidence rates indicate that KD is most common among Americans of Asian and Pacific Island descent (32.5/100 000 children <5 years of age), occurs with intermediate frequency in non-Hispanic blacks (16.9/100 000 children <5 years old) and Hispanics (11.1/100 000 children <5 years of age), and is least common in whites (9.1/100 000 children <5 years of age).[20] In the United States, KD is more common during the winter and

early spring months; boys outnumber girls by approximately 1.5:1 to 1.7:1; and 76% of children are <5 years of age.[21]
- The incidence of KD in the United States did not increase between 1988 and 1997.[21]

Peripheral Arterial Disease
PAD affects approximately 8 million Americans and is associated with significant morbidity and mortality.[22] Recently published data from multiple epidemiological studies demonstrate that approximately 8 million men and women ≥40 years of age have PAD.[23] Prevalence increases dramatically with age, and PAD disproportionately affects blacks.[24]

- PAD affects 12% to 20% of Americans ≥65 years of age.[25] Despite its prevalence and cardiovascular risk implications, only about 25% of PAD patients are undergoing treatment.[26] In the general population, only about 10% of persons with PAD have the classic symptom 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.[22,27] In an older, disabled population of women, however, as many as two thirds of individuals with PAD had no exertional leg symptoms.[28]
- Intermittent claudication is present in fewer than 1% of individuals <50 years of age and approximately 5% or more of those >80 years of age.[17]
- In the FHS (NHLBI), 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. The incidence of intermittent claudication has declined since 1950, but survival among persons with intermittent claudication has remained low.[29]
- The risk factors for PAD are similar to those for CHD, although diabetes and cigarette smoking are particularly strong risk factors for PAD.[17,30] Most studies suggest that the prevalence of PAD is similar in men and women.[31]
- 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 a significant decline in lower-extremity functioning over time.[32,33]
- Pooled data from 11 studies in 6 countries found that PAD is a marker for systemic atherosclerotic disease. The age- and sex-adjusted relative risk (RR) of all-cause death was 2.35; for CVD mortality, 3.34; and for CHD fatal and nonfatal events combined, 2.13. The findings for stroke were slightly weaker, but still significant, with a pooled RR of 1.86 for fatal and nonfatal events combined.[34]
- Data from NHANES 1999–2000 (NCHS) show that high 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.[35]
- Results from NHANES 1999–2000 (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.[36]
- Available evidence suggests that the prevalence of PAD in persons of Hispanic origin is similar to or slightly higher than that in non-Hispanic whites.[23,37]
- Recent studies indicate an association of elevated ankle brachial index levels with increased risk of all-cause and cardiovascular death.[38]
- Among patients with established PAD, higher physical activity levels during daily life are associated with better overall survival rate and a lower risk of death from CVD.[39]
- A cross-sectional, population-based telephone survey of >2500 adults ≥50 years of age, with oversampling of blacks and Hispanics, found that 26% expressed familiarity with PAD. Of these, half were not aware that diabetes and smoking increase the risk of PAD. One in 4 knew that PAD is associated with increased risk of heart attack and stroke, and only 14% were aware that PAD could lead to amputation. All knowledge domains were lower in individuals with lower income and education levels.[40]

Bacterial Endocarditis

ICD-9 421.0; ICD-10 I33.0.

Total-mention mortality—2438. Hospital discharges—30 000, primary plus secondary diagnoses.

- The 2007 AHA Guidelines on Prevention of Infective Endocarditis[41] state that infective endocarditis (IE) is thought to result from the following sequence of events: (1) formation of nonbacterial thrombotic endocarditis on the surface of a cardiac valve or elsewhere that endothelial damage occurs; (2) bacteremia; and (3) adherence of the bacteria in the bloodstream to nonbacterial thrombotic endocarditis and proliferation of bacteria within a vegetation.
- Viridans group streptococci are part of the normal skin, oral, respiratory, and gastrointestinal tract flora, and they cause ≥50% of cases of community-acquired native valve IE not associated with intravenous drug use.[42]
- Transient bacteremia is common with manipulation of the teeth and periodontal tissues, and reported frequencies of bacteremia due to dental procedures vary widely: tooth extraction (10% to 100%), periodontal surgery (36% to 88%), scaling and root planing (8% to 80%), teeth cleaning (up to 40%), rubber dam matrix/wedge placement (9% to 32%), and endodontic procedures (up to 20%). Transient bacteremia also occurs frequently during routine daily activities unrelated to dental procedures: tooth brushing and flossing (20% to 68%), use of wooden toothpicks (20% to 40%), use of water irrigation devices (7% to 50%), and chewing food (7% to 51%). Considering that the average person living in the United States has fewer than 2 dental visits per year, the frequency of bacteremia from routine daily activities is far greater than that associated with dental procedures.[41]
- Although the absolute risk for IE from a dental procedure is impossible to measure precisely, the best available

estimates are as follows: If dental treatment causes 1% of all cases of viridans group streptococcal IE annually in the United States, the overall risk in the general population is estimated to be as low as 1 case of IE per 14 million dental procedures. The estimated absolute risk rates for IE from a dental procedure in patients with underlying cardiac conditions are[41]:

- — Mitral valve prolapse: 1 per 1.1 million procedures;
- — CHD: 1 per 475 000;
- — Rheumatic heart disease: 1 per 142 000;
- — Presence of a prosthetic cardiac valve: 1 per 114 000; and
- — Previous IE: 1 per 95 000 dental procedures.

Although these calculations of risk are estimates, it is likely that the number of cases of IE that results from a dental procedure is exceedingly small. Therefore, the number of cases that could be prevented by antibiotic prophylaxis, even if prophylaxis were 100% effective, is similarly small. One would not expect antibiotic prophylaxis to be near 100% effective, however, because of the nature of the organisms and choice of antibiotics.[41]

Cardiomyopathy

ICD-9 425; ICD-10 I42.

Mortality—25 580. Total-mention mortality—51 100. Hospital discharges—41 000.

- 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.[43]
- 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).[44]
  - — The overall incidence of cardiomyopathy is 1.13 cases per 100 000 in children <18 years of age.
  - — In children <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.[45]
- 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 of it.[46]

Rheumatic Fever/Rheumatic Heart Disease

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

Mortality—3254. Total-mention mortality—6020.

- The incidence of rheumatic fever remains high in African Americans, Puerto Ricans, Mexican Americans, and American Indians.[47]
- In 1950, approximately 15 000 Americans (adjusted for changes in ICD codes) died of rheumatic fever/rheumatic heart disease, compared with approximately 3200 today.
- From 1994 to 2004, the death rate from rheumatic fever/rheumatic heart disease fell 42.1%, while actual deaths declined 31.8%.
- The 2004 overall death rate for rheumatic fever/rheumatic heart disease was 1.1. Death rates were 0.8 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—20 260. Total-mention mortality—43 100. Hospital discharges—100 000.

Aortic Valve Disorders

ICD-9 424.1; ICD-10 I35.

Mortality—12 665. Total-mention mortality—26 660. Hospital discharges—51 000.

Mitral Valve Disorders

ICD-9 424.0; ICD-10 I34.

Mortality—2554. Total-mention mortality—about 6200. Hospital discharges—43 000.

- The NHLBI's FHS reports that among people 26 to 84 years of age, prevalence of mitral valve disorders is about 1% to 2% and equal between women and men.[48]

Pulmonary Valve Disorders

ICD-9 424.3; ICD-10 I37.

Mortality—13. Total-mention mortality—42.

Tricuspid Valve Disorders

ICD-9 424.2; ICD-10 I36.

Mortality—10. Total-mention mortality—89.

Endocarditis, Valve Unspecified

ICD-9 424.9; ICD-10 I38.

Mortality—5018. Total mention mortality—10 116. Hospital discharges—5000.

Venous Thromboembolism

- Venous thromboembolism (VTE) 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 VTE manifest pulmonary embolism (PE), whereas two thirds manifest deep vein thrombosis (DVT) alone.[49]
- Whites and blacks have a significantly higher incidence than Hispanics and Asians or Pacific Islanders.[49]
- In studies in Worcester, Mass, and Olmsted County, Minn, the incidence of VTE was about 1 in 1000. In both studies, VTE was more common in men; for each 10-year increase in age, the incidence doubled. By extrapolation, it is estimated that >250 000 patients are hospitalized annually with VTE.[50]

- 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 VTE were women, and 72% were white.[51]
- More than 200 000 new cases of VTE occur annually. Of these, 30% die within 30 days, one fifth suffer sudden death due to PE, and about 30% develop recurrent VTE within 10 years. Independent predictors for recurrence include increasing age, obesity, malignant neoplasm, and extremity paresis.[52]
- 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%.[53]
- The RR of VTE among pregnant or postpartum women was 4.29%, and the overall incidence of VTE (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 VTE during pregnancy remained relatively constant, whereas the postpartum incidence of PE decreased >2-fold.[54]
- On the basis of a prospective study of black and white middle-aged adults in the ARIC study of the NHLBI, it was found that consumption of ≥4 servings of fruit and vegetables per day or ≥1 serving of fish per week was associated with lower incidence of VTE. In a comparison of the highest quintile of intake with the lowest, red and processed meat and a Western diet pattern were positively associated with incident VTE.[55]
- Results from phase I of the WHO Research Into Global Hazards of Travel (WRIGHT) project found that the risk of developing VTE approximately doubles after travel lasting 4 hours or more. However, the absolute risk of developing VTE if seated and immobile for more than 4 hours remains relatively low, at about 1 in 6000. Other risk factors that increase the risk of VTE during travel are obesity, being very tall or very short, use of oral contraceptives, and inherited blood disorders that lead to increased clotting tendency. One study within the project examining flights in particular found that those taking multiple flights over a short period of time are also at higher risk.[56] This is because the risk of VTE remains elevated for about 4 weeks.

Deep Vein Thrombosis
ICD-9 451.1; ICD-10 I80.2.

Mortality—2843. Total-mention mortality—11 190. Hospital discharges—6300.

- 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.[57]
- Death occurs in about 6% of DVT cases within 1 month of diagnosis.[49]

Pulmonary Embolism
ICD-9 415.1; ICD-10 I26.

Mortality—8113. Total-mention mortality—26 540. Hospital discharges—140 000.

- In the Nurses' Health Study, nurses ≥60 years of age in the highest BMI quintile had the highest rates of PE. Heavy cigarette smoking and HBP were also identified as risk factors for PE.[50]
- Death occurs in about 12% of PE cases within 1 month of diagnosis.[49]
- A study of Medicare recipients ≥65 years of age 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%).[50]
- 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.[50]
- 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.[58]

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Table 8-1. Rheumatic Fever/Rheumatic Heart Disease

Population Group	Mortality, 2004 All Ages*	Hospital Discharges, 2005 All Ages
Both sexes	3254	53 000
Males	1009 (31.0%)†	18 000
Females	2245 (69.0%)†	25 000
White males	898	. . .
White females	2013	. . .
Black males	84	. . .
Black females	163	. . .

Ellipses (. . .) indicate data not available.

*Mortality data are for whites and blacks and include Hispanics.

†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. 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.

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 male students and 8.7% of female students reported current cigar use, and 13.6% of male students and 2.2% of female students reported current smokeless tobacco use.[1]
- From 1980 to 2005, the percentage of high school seniors who reported smoking in the previous month decreased 24%. Smoking decreased by 7.5% in males, 38% in females, 11% in whites, and 57.5% in blacks.[2]
- Each year, 150 000 to 300 000 children <18 months of age have respiratory tract infections because of exposure to secondhand smoke (SHS).[3]
- Among youths 12 to 17 years of age in 2005, 3.3 million (13.1%) used a tobacco product in the past month, and 2.7 million (10.8%) used cigarettes. The rate of cigarette use in the past month declined from 13.0% in 2002 to 10.8% in 2005. Cigar use in the past month declined to 4.2% in 2005 from 4.8% in 2004. Smokeless tobacco use was reported by 2.1% of youths in 2005, similar to estimates since 2002.[4]

Adults

- Since 1965, smoking in the United States has declined by 50% among people ≥18 years of age (NCHS).[2]
- In 2005, among Americans ≥18 years of age, 23.9% of men and 18.1% of women were cigarette smokers, putting them at increased risk of heart attack and stroke.[5]
- Rates of use of any tobacco product in 2004 were 31.4% for whites only, 27.3% for blacks only, 33.8% for American Indians or Alaska Natives only, 11.7% for Asians only, and 23.3% for Hispanics or Latinos of any race.[2]
- In 2005 (NHIS/NCHS), smoking prevalence was higher among those with a general equivalency diploma (43.2%) and those with 9 to 11 years of education (32.6%) than among those with >16 years of education (7.1%). It was highest (29.9%) among persons living below the poverty level versus other income groups.[5]
- In 2005, non-Hispanic American Indian or Alaska Native adults ≥18 years of age were more likely (32.0%) to be current smokers than were non-Hispanic white adults (21.9%), non-Hispanic black adults (21.5%), and non-Hispanic Asian adults (13.3%).[5]
- BRFSS/CDC 2006 prevalence data showed that overall, 20.1% of adults ≥18 years of age were current smokers. The highest percentage was in Kentucky (28.5%), and the lowest was in Utah (9.8%).[6]
- Among women 15 to 44 years of age, rates of past-month cigarette smoking were lower for pregnant than for nonpregnant women; however, among those 15 to 17 years of age, there was no significant difference in the smoking rate for pregnant women versus nonpregnant women (22.3% versus 18.5%).[4]
- Between 1965 and 2004–2005, the age-adjusted prevalence of noninstitutionalized women ≥65 years of age who were current smokers increased from 8% in 1965 to 13% in the mid-1980s, and then decreased back to 8% in 2004–2005. In 2004–2005, 28% of women and 49% of men ≥65 years of age (age adjusted) had previously smoked cigarettes.[7]

Abbreviations Used in Chapter 9

BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CVD	cardiovascular disease
HF	heart failure
MI	myocardial infarction
NCHS	National Center for Health Statistics
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung, and Blood Institute
SHS	secondhand smoke
TIPS	Tobacco Information and Prevention Source
YRBS	Youth Risk Behavior Surveillance

Incidence

- Each day, approximately 4000 people 12 to 17 years of age initiate cigarette smoking in the United States. In this age group, each day, an estimated 1140 people become daily smokers.[4]
- Data from 2002–2004 from the National Survey on Drug Use and Health (CDC) suggest that approximately 1 in 5 nonsmokers 12 to 17 years of age is likely to start smoking. Youths in Mexican subpopulations were significantly more susceptible (28.8%) to start smoking than those in non-Hispanic white (20.8%), non-Hispanic black (23.0%), Cuban (16.4%), Asian Indian (15.4%), Chinese (15.3%), and Vietnamese (13.8%) subpopulations. There was no significant difference in susceptibility to smoking between male and female youths in any of the major populations or subpopulations.[8]
- Approximately 80% of people who use tobacco began before age 18 years, according to a report from the Surgeon General of the United States.[9] The most common age of initiation is 14 to 15 years.[9]

Mortality

- From 1997 to 2001, an estimated 438 000 Americans died each year of smoking-related illnesses, and 34.7% of these deaths were related to CVD.[10]
- Cigarette smoking kills an estimated 178 000 women in the United States annually.[11]
- On average, male smokers die 13.2 years earlier than male nonsmokers, and female smokers die 14.5 years earlier than female nonsmokers.[12]

- From 1997 to 2001, each year, smoking caused 3.3 million years of potential life lost for men and 2.2 million years for women.[10]
- From 1997 to 2001, smoking during pregnancy resulted in an estimated 910 infant deaths annually.[10]
- Current cigarette smoking is a powerful independent predictor of cardiac arrest in patients with CHD.[13]
- After up to 14.5 years of follow-up of participants in the Lung Health Study of the NHLBI, the all-cause death rate among participants in a smoking-cessation intervention was significantly lower (15%) than among those given usual care.[14]
- The CDC fact sheet on tobacco-related mortality[15] dated September 2006 stated that:

  — Cigarette smoking results in a 2- to 3-fold increased risk of dying of CHD.
  — On average, adults who smoke cigarettes die 14 years earlier than nonsmokers.
  — Cigarette smoking kills an estimated 259 500 men and 178 000 women in the United States each year.

Secondhand Smoke

- The Global Youth Tobacco Survey (2000–2007, CDC) among students 13 to 15 years of age who had never smoked showed that nearly half were exposed to SHS at home (46.8%), and a similar percentage (47.8%) were exposed in places other than the home. Those exposed to SHS were more likely to initiate smoking than those not exposed (1.4- to 2.1-fold increase for those exposed to SHS at home and 1.3- to 1.8-fold increase for those exposed to SHS elsewhere).[16]
- Data from the "Tobacco Use Supplement" to the "Current Population Survey" from 1992 to 2003 showed that the national prevalence of households with smoke-free home rules increased from 43.2% during 1992–1993 to 72.2% in 2003. During this period, the prevalence of such rules increased from 9.6% to 31.8% among households with at least 1 smoker and from 56.8% to 83.5% among households with no smokers. Approximately 126 million children and nonsmoking adults were still exposed to SHS in the United States as of 1999–2002.[17]
- An estimated 21% of all adults (45 million) smoke cigarettes. More than 126 million nonsmoking people in the United States continue to be exposed to SHS. Almost 60% of children in the United States 3 to 11 years of age, or almost 22 million children, are exposed to SHS.[18]
- Children's exposure to SHS, as indicated by cotinine levels, decreased between 1988 and 1994 and between 1999 and 2002 (NHANES/NCHS). Overall, 59% of those 4 to 11 years of age were exposed in 1999–2002 versus 88% in 1988–1994. From 1999 to 2002, 84% of non-Hispanic black children between the ages of 4 and 11 years were exposed versus 58% of non-Hispanic white children and 47% of Mexican-American children. The percentage of homes with children <7 years of age in which someone regularly smoked decreased from 29% in 1994 to 11% in 2003.[19]
- 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 ≈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.[20]

Aftermath

- The 2004 report of the Surgeon General on the health consequences of smoking (CDC)[12] states:

  — One third of those who receive percutaneous coronary artery revascularization 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.
  — A study of women <44 years of age 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 compared with nonsmokers, which rose to 74.6 for those smoking >40 cigarettes per day.
  — The risk of stroke decreases steadily after smoking cessation. Former smokers have the same risk as nonsmokers after 5 to 15 years.

- Data from a 2006 report of the US Surgeon General on the consequences of involuntary exposure to tobacco smoke[21] indicate the following:

  — Risk of CHD increases 25% to 30% from exposure to SHS.
  — SHS is estimated to cause from 22 700 to 69 600 premature deaths due to heart disease annually among nonsmokers.
  — In persons who already have heart disease, SHS exposure can make a heart attack more severe than it would have been in the absence of exposure.
  — Adults who breathe 5 hours of SHS daily have higher levels of LDL cholesterol that can clog the arteries of the heart, as well as impaired functioning of the heart, blood, and vascular systems.

- The CDC Tobacco Information and Prevention Source (TIPS)[22] states that the risk for CHD, stroke, and peripheral vascular disease is reduced after smoking cessation. CHD risk is reduced substantially within 1 to 2 years of cessation, and heart attack patients reduce their risk of a second heart attack.

  — An estimated 46.5 million adults were former smokers in 2005.
  — More than 54% of current high school cigarette smokers in the United States tried to quit smoking within the preceding year.[23]

- Among ever-smokers who had 1 circulatory disorder, 52.1% were current smokers, and among those who reported that they had ≥3 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 central circulatory disorders, such as MI, HF, or stroke, than for ever-smokers without a central circulatory disorder.[24]
- The CDC "Health Effects of Cigarette Smoking" fact sheet[25] 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 >10 times as likely as nonsmokers to develop peripheral vascular disease.
  — Smoking increases risk of abdominal aortic aneurysm.

Smokeless Tobacco

- In 2005, an estimated 7.7 million Americans ≥12 years of age (3.2%) used smokeless tobacco.[4]
- Data from the CDC fact sheet on smokeless (oral) tobacco,[26] based on the results of the 2005 National Survey on Drug Use and Health, indicate:

  — Nationally, an estimated 3% of adults are current smokeless tobacco users. Approximately 6% of men and 0.4% of women use smokeless tobacco.
  — Nine percent of American Indian/Alaska Natives, 4% of whites, 2% of African Americans, 1% of Hispanics, and 0.6% of Asian-American adults are current smokeless tobacco users.
  — Eight percent of high school students are current smokeless tobacco users. Smokeless tobacco use is more common among male (13.6%) than female (2.2%) high school students. Estimates by race/ethnicity are 10.2% among whites, 5.1% for Hispanics, and 1.7% for African Americans.
  — An estimated 3% of middle school students are current smokeless tobacco users. Smokeless tobacco is more common among male (4%) than female (2%) middle school students. Estimates by race/ethnicity are 3% for white, 1% for Asian, 2% for African-American, and 4% for Hispanic middle school students.

Cost

Direct medical costs ($75.5 billion) and lost productivity costs associated with smoking ($92 billion) total an estimated $167 billion per year.[10]

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Table 9-1. Cigarette Smoking

Population Group	Prevalence, 2005* Age ≥18 y	Cost,[10] 1997 to 2001
Both sexes	46 600 000 (20.9%)	$167 billion per year
Males	25 900 000 (23.9%)	...
Females	20 700 000 (18.1%)	...
NH white males	24.0%	...
NH white females	20.0%	...
NH black males	26.7%	...
NH black females	17.3%	...
Hispanic males	21.1%	...
Hispanic females	11.1%	...
NH Asian-only males	20.6%	...
NH Asian-only females	6.1%	...
NH American Indian/Alaska Native males	37.5%	...
NH American Indian/Alaska Native females	26.8%	...

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

*Data are for 2005 for Americans ≥18 years of age. NHIS/NCHS percentages applied to 2005 population estimates.[5]

Table 9-2. Cigarette Smoking in the Past Month by Race/Ethnicity, Age, and Sex in the United States, 2005

Demographic Characteristic	Ages 12 to 17 y	Age ≥18 y
Total	10.8	26.5
Male	10.7	29.5
Female	10.8	23.8
NH white	12.8	27.3
NH black or African American	6.5	27.3
NH American Indian or Alaska Native	18.0	38.7
NH Asian	3.0	14.6
Hispanic or Latino	9.1	24.2
NH white male	12.5	NR
NH white female	13.0	NR
NH black male	7.4	NR
NH black female	5.6	NR
Hispanic male	9.2	NR
Hispanic female	9.1	NR

NR indicates data not provided. Values are percentages.

Source: Percentage of persons between 12 and 17 years of age and ≥18 years of age reporting cigarette use during the past month, by race/ethnicity and sex.[4]

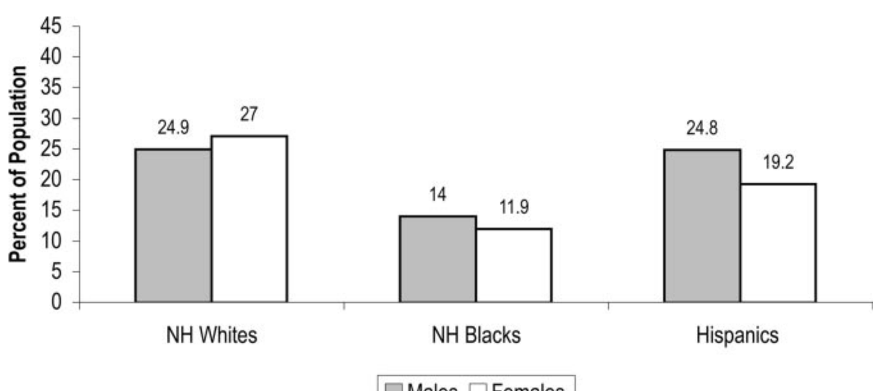

Chart 9-1. Prevalence of students in grades 9 through 12 reporting current cigarette use by sex and race/ethnicity (YRBS: 2005). Source: MMWR.[1] NH indicates non-Hispanic.

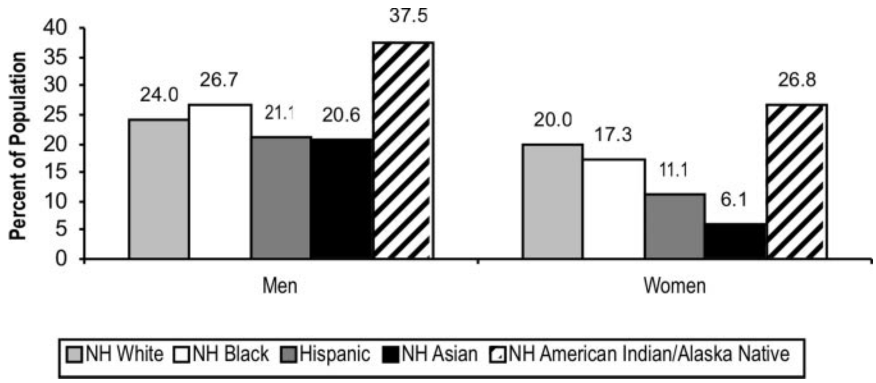

Chart 9-2. Prevalence of current smoking for adults ≥18 years of age by race/ethnicity and sex (NHIS: 2005). Source: MMWR.[5] NH indicates non-Hispanic.

10. Risk Factor: High Blood Cholesterol and Other Lipids

See Table 10-1 and Charts 10-1 and 10-2.

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 4 to 11 years of age, the mean total blood cholesterol level is 164.5 mg/dL. For boys, it is 163.9 mg/dL; for girls, it is 165 mg/dL. The racial/ethnic breakdown is as follows (NHANES 2003–2004, NCHS; unpublished analysis):
  - For non-Hispanic whites, 163.9 mg/dL for boys and 166.2 mg/dL for girls.
  - For non-Hispanic blacks, 165.0 mg/dL for boys and 164.8 mg/dL for girls.
  - For Mexican Americans, 161.3 mg/dL for boys and 164.2 mg/dL for girls.
- Among adolescents 12 to 19 years of age, the mean total blood cholesterol level is 161.7 mg/dL. For boys, it is 158.3 mg/dL; for girls, it is 165.4 mg/dL. The racial/ethnic breakdown is as follows (NHANES 2003–2004, NCHS; unpublished analysis):
  - For non-Hispanic whites, 157.1 mg/dL for boys and 167.5 mg/dL for girls.
  - For non-Hispanic blacks, 161.3 mg/dL for boys and 162.7 mg/dL for girls.
  - For Mexican Americans, 159.6 mg/dL for boys and 161.4 mg/dL for girls.
- About 10.8% of adolescents 12 to 19 years of age have total cholesterol levels >200 mg/dL (NHANES 2003–2004, NCHS; unpublished analysis).

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
ICD	International Classification of Diseases
LDL	low-density lipoprotein
MEPS	Medical Expenditure Panel Survey
mg/dL	milligrams per deciliter
mmol/L	millimoles per litre
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHANES	National Health and Nutrition Examination Survey
NHLBI	National Heart, Lung, and Blood Institute

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.[1]
- A 10% (population-wide) decrease in total cholesterol levels may result in an estimated 30% reduction in the incidence of CHD.[2]
- Data from NHANES 1999–2002 (NCHS) 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.[3]
- Between 1988–1994 and 1999–2002 (NHANES/NCHS), the age-adjusted mean total serum cholesterol level of adults ≥20 years of age decreased from 206 to 203 mg/dL, HDL levels increased from 50.7 to 51.3 mg/dL, and LDL cholesterol levels decreased from 129 to 123 mg/dL.[4]
- Data from NHANES 2001 to 2004 (NCHS) showed the serum total age-adjusted mean cholesterol level in adults ≥20 years of age to be 201 mg/dL for men and 202 mg/dL for women.[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 in 1980–1982 and 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 35 and 74 years of age. 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 (CDC) survey in 2005 showed that, overall, 35.6% of adults ≥18 years of age had been told that they had high blood cholesterol. The highest percentage was in West Virginia (39.9%), and the lowest was in Louisiana (30.3%).[7]

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[8]:

- 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; <20% of CHD patients are at their LDL goal.

LDL (Bad) Cholesterol

Youth

- Among adolescents 12 to 19 years of age, the mean LDL cholesterol level is 90.5 mg/dL. For boys, it is 89.6 mg/dL; for girls, it is 91.4 mg/dL. The racial/ethnic breakdown is as follows (NHANES 2003–2004, NCHS; unpublished analysis):

— Among non-Hispanic whites, 90.3 mg/dL for boys and 91.5 mg/dL for girls.
— Among non-Hispanic blacks, 87.9 mg/dL for boys and 91.4 mg/dL for girls.
— Among Mexican Americans, 89.9 mg/dL for boys and 92 mg/dL for girls.

Adults

- The mean level of LDL cholesterol for American adults ≥20 years of age 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.[4]
- 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.

- The age-adjusted prevalence of high LDL cholesterol in US adults was 26.6% in 1988–1994 and 25.3 in 1999–2004 (NHANES/NCHS). Between 1988–1994 and 1999–2004, awareness increased from 39.2% to 63.0%, and use of pharmacological lipid-lowering treatment increased from 11.7% to 40.8%. LDL cholesterol control increased from 4.0% to 25.1% among those with high LDL cholesterol. In 1999–2004, rates of LDL cholesterol control were lower among adults 20 to 49 years of age than among those ≥65 years of age (13.9% versus 30.3%), among non-Hispanic blacks and Mexican Americans than among non-Hispanic whites (17.2% and 16.5% versus 26.9% respectively), and among males than among females (22.6% versus 26.9%).[9]

HDL (Good) Cholesterol

Youth

- Among children 4 to 11 years of age, the mean HDL cholesterol level is 55.2 mg/dL. For boys, it is 56.2 mg/dL; for girls, it is 54.2 mg/dL. The racial/ethnic breakdown is as follows (NHANES 2003–2004, NCHS; unpublished analysis):

— Among non-Hispanic whites, 54.7 mg/dL for boys and 53.3 mg/dL for girls.
— Among non-Hispanic blacks, 59.7 mg/dL for boys and 57.1 mg/dL for girls.
— Among Mexican Americans, 54.5 mg/dL for boys and 53.7 mg/dL for girls.

- Among adolescents 12 to 19 years of age, the mean HDL cholesterol level is 52.6 mg/dL. For boys, it is 49.9 mg/dL; for girls, it is 56.5 mg/dL. The racial/ethnic breakdown is as follows (NHANES 2003–2004, NCHS; unpublished analysis):

— Among non-Hispanic whites, 47.0 mg/dL for boys and 56.5 mg/dL for girls.
— Among non-Hispanic blacks, 54.4 mg/dL for boys and 57.6 mg/dL for girls.
— Among Mexican Americans, 49.4 mg/dL for boys and 53.7 mg/dL for girls.

Adults

- An HDL cholesterol level below 40 mg/dL in adults is considered low—a risk factor for heart disease and stroke. The mean level of HDL cholesterol for American adults ≥20 years of age is 51.3 mg/dL.[4]
- According to NHANES 1999–2002 (NCHS)[4]:

— Among non-Hispanic whites, mean HDL cholesterol levels were 45.5 mg/dL for men and 56.6 mg/dL for women.
— Among non-Hispanic blacks, mean HDL cholesterol levels were 51.0 mg/dL for men and 57.3 mg/dL for women.
— Among Mexican Americans, mean HDL cholesterol levels were 45.0 mg/dL for men and 52.9 mg/dL for women.

Triglycerides

- Among adolescents 12 to 19 years of age, the mean triglyceride level is 94.2 mg/dL. For boys, it is 96.7 mg/dL; for girls, it is 91.6 mg/dL. The racial/ethnic breakdown is as follows (NHANES 2003–2004, NCHS; unpublished analysis):

— Among non-Hispanic whites, 102.9 mg/dL for boys and 96.4 mg/dL for girls.
— Among non-Hispanic blacks, 71.2 mg/dL for boys and 69.6 mg/dL for girls.
— Among Mexican Americans, 98.7 mg/dL for boys and 99.9 mg/dL for girls.[10]

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Table 10-1. High Total and LDL Cholesterol and Low HDL Cholesterol

Population Group	Prevalence of Total Cholesterol ≥200 mg/dL, 2005 Age ≥20 y	Prevalence of Total Cholesterol ≥240 mg/dL, 2005 Age ≥20 y	Prevalence of LDL Cholesterol ≥130 mg/dL, 2005 Age ≥20 y	Prevalence of HDL Cholesterol <40 mg/dL, 2005 Age ≥20 y
Both sexes*	106 700 000 (48.4%)	37 200 000 (16.8%)	80 400 000 (32.5%)	44 600 000 (16.7%)
Males*	50 800 000 (47.8%)	17 200 000 (16.2%)	41 300 000 (32.2%)	32 100 000 (25.1%)
Females*	55 900 000 (48.6%)	19 900 000 (17.1%)	39 100 000 (32.4%)	12 500 000 (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† ≥20 y of age	...	29.9%	...	...
Total Asian/Pacific Islanders† ≥20 y of age	...	29.2%	...	...
Total American Indians/Alaska Natives, Alaska† ≥20 y of age	...	31.2%	...	...

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

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

†BRFSS (1991–2003, CDC), MMWR[10]; data are self-reported data for Americans ≥20 years of age.

Source for total cholesterol ≥200 mg/dL, ≥240 mg/dL, LDL, and HDL: NHANES (1999–2004), NCHS, and NHLBI. Estimates from NHANES 1999–2004 (NCHS) applied to 2005 population estimates.

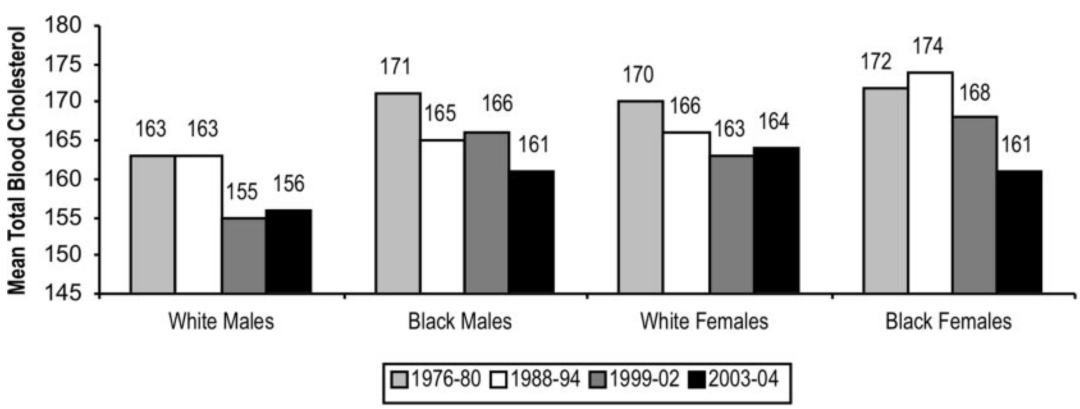

Chart 10-1. Trends in mean total serum cholesterol among adolescents between 12 and 17 years of age by race, sex, and survey (NHANES: 1976–1980, 1988–1994, 1999–2002, and 2003–2004). Source: NCHS and NHLBI.

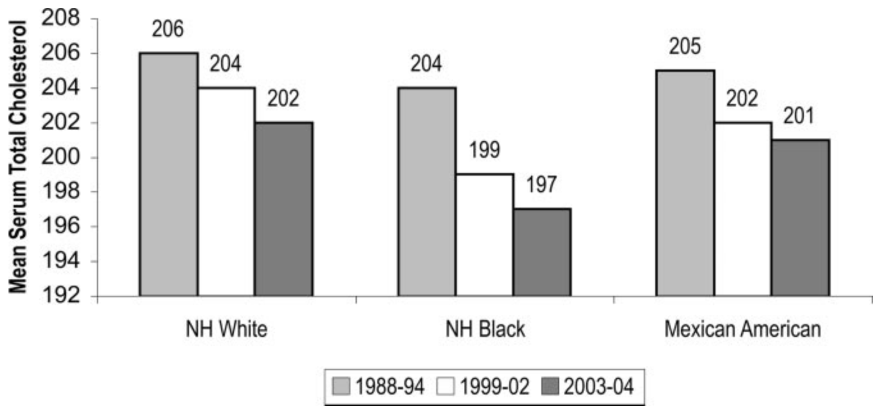

Chart 10-2. Trends in mean total serum cholesterol among adults by race and survey (NHANES: 1988–1994, 1999–2002, and 2003–2004). Source: NCHS and NHLBI.

11. Risk Factor: Physical Inactivity

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

Prevalence

Youth

- In 2005, 43.8% of male and 27.8% of female 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 >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 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 a decline in PA among white girls. Pregnancy is associated with a 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 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 for ≥3 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 female (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 System
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 (CDC) survey. Of these, 21.5% were overweight (BMI 25.0 to 29.9 kg/m^2), and 23.8% were obese (BMI ≥30.0 kg/m^2).[4]
- According to 2005 data from the BRFSS (CDC) survey, 76.2% of respondents ≥18 years of age had participated in any vigorous 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 ≥20 minutes of PA ≥3 days per week was 72.5%. The highest percentage was in Kentucky (83.2%), and the lowest was in California (63.8%). The percentage of adults with ≥30 minutes of moderate PA ≥5 days per week or ≥20 minutes of vigorous PA ≥3 days per week was 50.9%. The highest percentage was in Kentucky (65.3%), and the lowest was in Alaska (40.8%).[5]
- On the basis of age-adjusted data from the 2002–2004 NHIS (NCHS)[6]:

  — Overall, 62.0% of US adults ≥18 years of age engaged in at least some vigorous and/or light to moderate leisure-time PA lasting ≥10 minutes per session. Men (64.0%) were more likely than women (60.2%) to engage in at least some leisure-time PA.

  — Engaging in at least some PA declined steadily with age, from 68.6% of adults between the ages of 18 and 44 to 40.2% of those ≥75 years of age.

  — Engaging in at least some PA was more prevalent among white adults (63.7%) than black adults (51.3%).

  — Non-Hispanic white adults (66.1%) were more likely than non-Hispanic black adults (51.3%) and Hispanic or Latino adults (47.6%) to engage in at least some leisure-time PA.

  — 50.9% of widowed adults engaged in at least some leisure-time PA, compared with 61.0% of never-married adults, 63.2% of married adults, and 58.5% of divorced or separated adults.

- 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.[7]
- A study of >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.[8]
- The prevalence of physical inactivity during leisure time among Mexican Americans is higher than in the general population.[9]
  - 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 2005 NHIS survey of the NCHS showed that American Indian or Alaska Native adults ≥18 years of age were as likely (71.1%) as black adults (71.7%) and more likely than Asian adults (66.0%) and white adults (60.0%) to never engage in any vigorous leisure-time PA.[10]
- Analysis of data from the 2005 BRFSS of the CDC showed that in people ≥18 years of age, the percentage who were considered regularly active (regularly active was defined as engaging in moderate-intensity activity for ≥30 minutes per day, ≥5 days per week, or vigorous-intensity activity for ≥20 minutes per day, ≥3 days per week) was as follows[11]:
  - 52.5% for non-Hispanic white men and 49.8% for women;
  - 45.9% for non-Hispanic black men and 36.3% for women;
  - 42.5% for Hispanic men and 42.3% for women;
  - 55.5% for American Indian/Alaska Native men and 50.3% for women;
  - 37.5% for Asian/Pacific Islander men and 45.5% for women.
- In 2004–2005, 22% of noninstitutionalized people ≥65 years of age (age adjusted) engaged in regular leisure-time PA. Men were more likely (25%) to exercise than women (20%), although regular PA levels were low for both.[12]
- Data from the 2003 BRFSS (CDC) found that 53.2% of respondents with heart disease were told to be more physically active, 32% met recommended physical activity levels, and 30.8% were sedentary.[13]

Cost

- The annual estimated direct medical cost of physical inactivity in 2000 was $76.6 billion.[14,15]

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Table 11-1. Regular Leisure-Time PA

Population Group	Prevalence, 2006 (Age ≥18 y)
Both sexes	30.9%
Males	33.1%
Females	28.9%
NH white only	33.7%
NH black only	25.3%
Hispanic or Latino	22.6%

Regular leisure-time PA is defined as light to moderate activity for ≥30 minutes, ≥5 times per week, or vigorous activity for ≥20 minutes, ≥3 times per week.

Data are age adjusted for adults ≥18 years of age.

Source: NHIS 2006 (NCHS).[16]

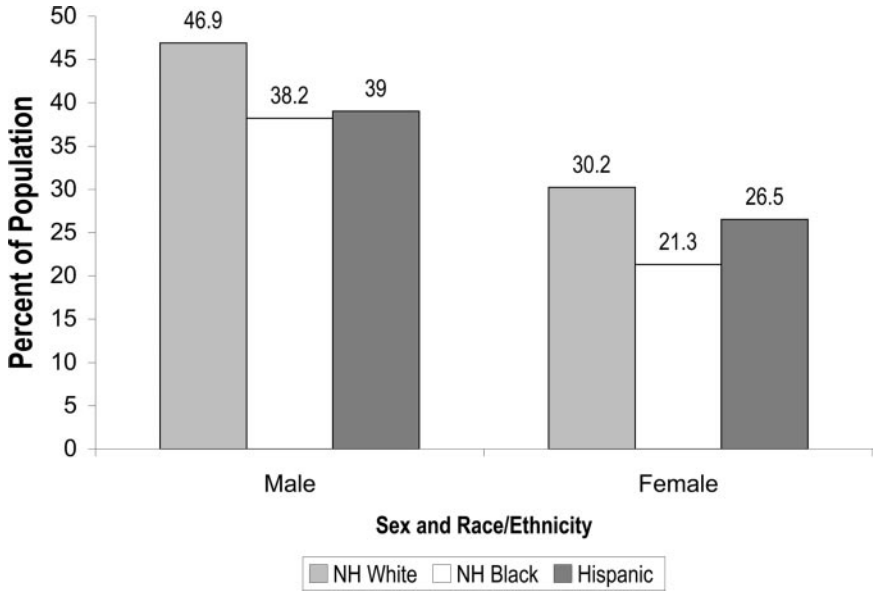

Chart 11-1. Prevalence of students in grades 9 through 12 who met currently recommended levels of PA during the past 7 days by race/ethnicity and sex (YRBS: 2005). "Currently recommended levels" are defined as activity that increased students' heart rates and made them breathe hard some of the time for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

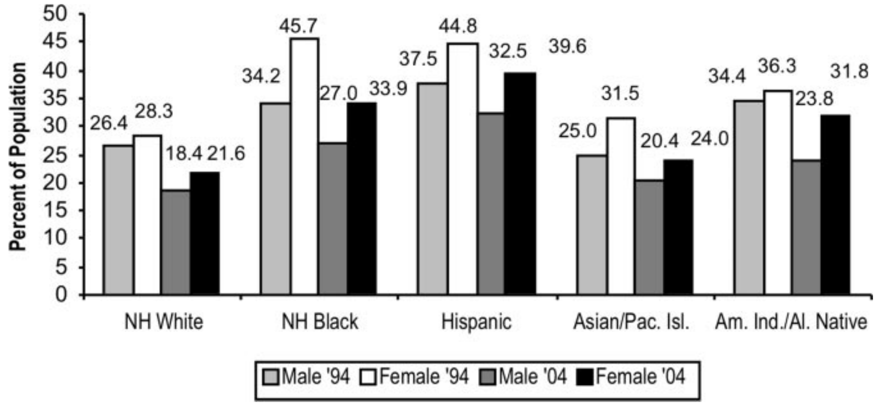

Chart 11-2. Prevalence of leisure-time physical inactivity among adults ≥18 years of age by race/ethnicity and sex (BRFSS: 1994 and 2004). Source: MMWR.[15]

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 (NCHS), 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 years increased from 6.1% to 17.0% in that same time frame.[2]
- Among infants and children between the ages of 6 and 23 months, the prevalence of overweight was 7.2% in 1976–1980 and 11.5% in 2003–2004 (NHANES, NCHS).[3]
- 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 years, 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 years, the following are overweight: 17.3% of non-Hispanic whites, 21.8% of non-Hispanic blacks, and 16.3% of Mexican Americans.
  — Another 16.5% of children and teens between the ages of 2 and 19 years 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 1 or both parents are overweight or obese.[4]
- 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.[5]
- In 2005, in 15 "steps communities" of the YRBS (CDC), in grades 9 through 12, 9.6% to 20.5% of male students and 6.1% to 21.7% of female students were at risk for becoming overweight (BMI from the 85th to 94th percentile); 9.5% to 25.4% of males and 3.5% to 14.9% of females were overweight (BMI 95th percentile or greater).[6]
- Data from NHANES 1999–2002 (NCHS) showed that among all overweight children and teens between the ages of 2 and 19 years (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 years, this percentage was 17.4%; for those between the ages of 6 and 11 years, 32.6%; for those between the ages of 12 and 15 years, 39.6%; and for those between the ages of 16 and 19 years, 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%, respectively). Among those informed of overweight status, 39% of non-Hispanic black females were severely overweight (BMI ≥99th percentile for age and sex) compared with 17% of non-Hispanic white females.[7]

Adults

- Analysis of the FHS, 1971–2001 (NHLBI), showed that among normal-weight white adults between the ages of 30 and 59 years, the 4-year rates of developing overweight varied from 14% to 19% in women and from 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 ≥35 kg/m^2) 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.[8]

Abbreviations Used in Chapter 12

BMI	body mass index
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CI	confidence interval
FHS	Framingham Heart Study
HHP	Honolulu Heart Program
kg/m^2	kilograms per square meter
NCHS	National Center for Health Statistics
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung, and Blood Institute
NINDS	National Institute of Neurological Diseases and Stroke
NOMAS	Northern Manhattan Study
OR	odds ratio
WHO	World Health Organization
YRBS	Youth Risk Behavior Surveillance

- The age-adjusted prevalence of overweight and obesity (BMI ≥25 kg/m^2) increased from 64.5% in NHANES 1999–2000 (NCHS) to 66.3% in NHANES 2003–2004 (NCHS). The prevalence of obesity (BMI ≥30 kg/m^2) increased during this period from 30.5% to 32.2%. Extreme obesity (BMI ≥40.0 kg/m^2) increased from 4.7% to 4.8%.[1]
- According to 2006 data from the BRFSS/CDC survey, based on self-reported height and weight, 25.1% of adults are obese. By state, the highest prevalences of obesity were seen in Mississippi, West Virginia, and Alabama. The lowest prevalence was seen in Colorado.[9]
- Abdominal obesity is an independent risk factor for ischemic stroke in all race/ethnic groups, with an OR ≈3 times greater when the first and fourth quartiles are compared. This effect was larger for those <65 years of age (OR 4.4) than those >65 years of age (OR 2.2; NOMAS, NINDS).[10]
- A recent comparison of risk factors in both the HHP and FHS (NHLBI) showed that a BMI increase of ≈3 kg/m^2 raised the risk of hospitalized thromboembolic stroke by 10% to 30%.[11]
- 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 years.[12]
- 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 compared with normal-weight nonsmokers.[13]
- Data from the 2005 NHIS study of the NCHS showed that American-Indian or Alaska Native adults ≥18 years of age were less likely (22.3%) than black adults (31.1%), white adults (38.4%), and Asian adults (57.9%) to be at a healthy weight.[14]
- Data from the 2005 NHIS study of the NCHS showed that American-Indian or Alaska Natives ≥18 years of age were more likely (37.6%) to be obese than blacks (32.4%), whites (24.1%), and Asians (8.5%).[14]
- The WHO estimates that by 2015, the number of overweight people globally will increase to 2.3 billion, and >700 million will be obese. At least 20 million children <5 years of age were overweight globally in 2005. Once considered a problem only in high-income countries, overweight and obesity are now dramatically on the rise in low- and middle-income countries, particularly in urban settings.[15]
- On the basis of data from NHANES 2001–2002 (NCHS), racial disparities were observed among women but 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 the rates of obesity were compared: 41.5% of black women were obese, compared with 19.3% of white women and 26.2% of Hispanic women.[16]
- In 2003–2004, 36% of noninstitutionalized women between the ages of 65 and 74 years and 24% of women ≥75 years of age were obese. This is an increase from 1988–1994, when 27% of women between the ages 65 and 74 years and 19% of women ≥75 years of age were obese. For men, from 1988–1994, 24% of those between the ages of 65 and 74 years and 13% of those ≥75 years of age were obese, compared with 33% of those between the ages of 65 and 74 years and 23% of those ≥75 years of age in 2003–2004.[17]
- A study of Medicare beneficiaries from 1997 to 2002 found the prevalence of obesity increased by 5.6%, or ≈2.7 million beneficiaries. By 2002, 21.4% of aged beneficiaries and 39.3% of disabled beneficiaries were obese, compared with 16.4% and 32.5%, respectively, in 1997. The rise in obesity, along with expansions in treatment coverage, could greatly increase obesity-related Medicare spending.[18]

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. Grade I obesity (BMI 30 to <35 kg/m^2) was associated with almost 30 000 of these excess deaths (95% CI 8534 to 68 220) and grade II to III obesity (BMI ≥35 kg/m^2) with >82 000 (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 kg/m^2) was not associated with excess deaths.[19] However, other studies suggest that overweight may be associated with CHD death.[20,21]

Cost

- Among children and adolescents, annual hospital costs related to obesity were $127 million between 1997 and 1999.[22]
- According to one study, annual medical spending due to overweight and obesity could be as high as $92.6 billion in 2002 dollars, which represents 9.1% of US health expenditures.[23] According to another estimate, the 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 among Americans 17 to 64 years of age is $3.9 billion (1994).[24]

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Table 12-1. Overweight and Obesity

Population Group	Prevalence of Overweight and Obesity in Adults, 2005 Age ≥20 y	Prevalence of Obesity in Adults, 2005 Age ≥20 y	Prevalence of Overweight in Children, 2005 Ages 6–11 y	Prevalence of Overweight in Adolescents, 2005 Ages 12–19 y	Cost, 2002*
Both sexes	142 000 000 (66.0%)	67 300 000 (31.4%)	4 200 000 (17.5%)	5 700 000 (17.0%)	$117 billion
Males	73 000 000 (70.5%)	30 700 000 (29.5%)	2 300 000 (18.7%)	3 100 000 (17.9%)	...
Females	69 000 000 (61.6%)	36 700 000 (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 y†	39.6%	27.5%	...	...	...
Asian only age ≥18 y†	27.9%	8.5%	...	...	...
American Indian/Alaska Native age ≥18 y†	38.6%	37.6%	...	...	...

Ellipses (...) indicate data not available. Data for white, black, and Asian or Pacific Islander males and females are for non-Hispanics.

Overweight and obesity in adults is BMI ≥25 kg/m². Obesity in adults is ≥BMI 30 kg/m². Overweight in children and adolescents was defined as being ≥95th percentile of the sex-specific BMI-for-age CDC 2000 growth chart.

In January 2007, the American Medical Association's Expert Task Force on Childhood Obesity recommended new definitions for overweight and obesity in children and adolescents (available at: http://www.ama-assn.org/ama1/pub/upload/mm/433/ped_obesity_recs.pdf). However, statistics based on this new definition are not yet available.

*Data from NIDDK.[24]

†NHIS (2005), NCHS; data are age-adjusted for Americans aged ≥18 years. Overweight is BMI ≥25 kg/m² and <30.0 kg/m². Obese is BMI ≥30.0 kg/m².

Sources: NHANES 2001–2004 (NCHS); *Health, United States, 2006*[2]; and unpublished data. Data in adults are for age ≥20 years. Estimates from NHANES 2001–2004 (NCHS) applied to 2005 population estimates.

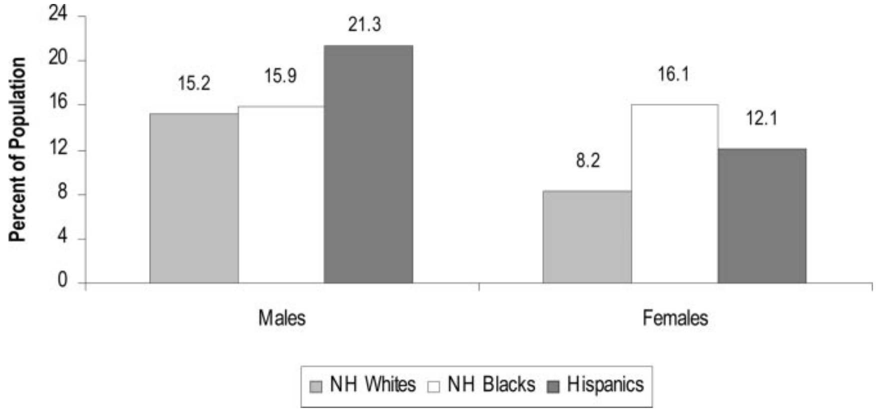

Chart 12-1. Prevalence of overweight among students in grades 9–12 by sex and race/ethnicity (YRBS: 2005). Source: BMI ≥95th percentile by age and sex of the CDC 2000 growth chart.[5] NH indicates non-Hispanic.

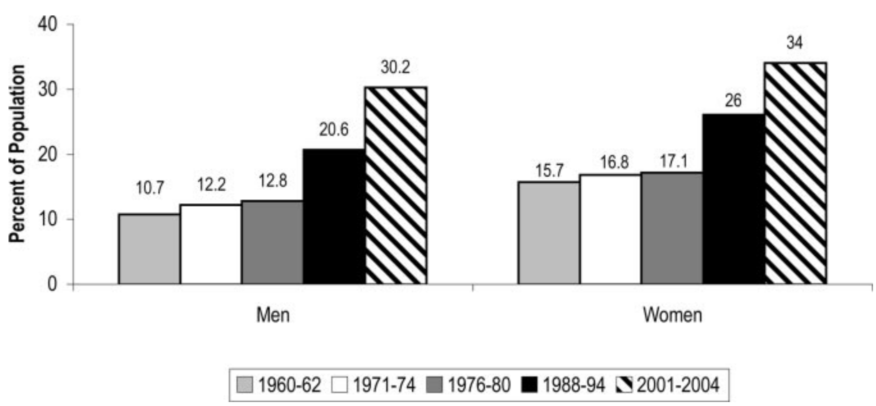

Chart 12-2. Age-adjusted prevalence of obesity in adults, ages 20–74, by sex and survey (NHES: 1960–1962; NHANES: 1971–1974, 1976–1980, 1988–1994, and 2001–2004). Note: Obesity is defined as a BMI ≥30.0 kg/m². Source: *Health, United States, 2006*.[2]

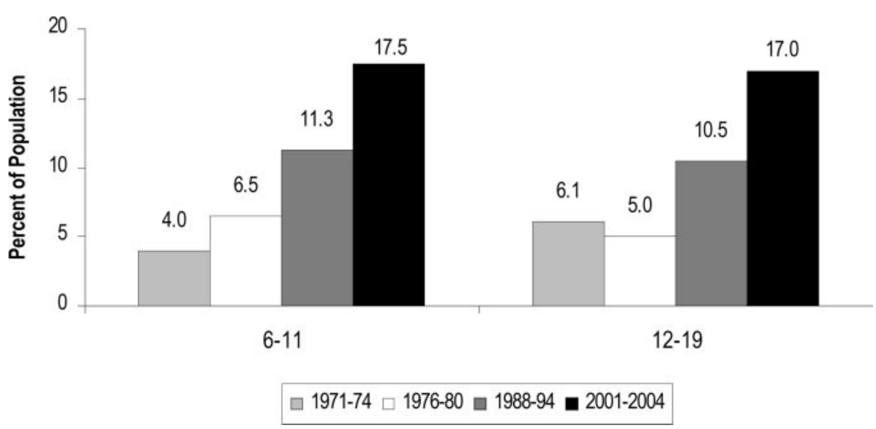

Chart 12-3. Trends in the prevalence of overweight among US children and adolescents by age and survey (NHANES: 1971–1974, 1976–1980, 1988–1994, and 2001–2004). Source: *Health, United States, 2006*.[2]

13. Risk Factor: Diabetes Mellitus

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

Prevalence

Youth

- In the SEARCH for Diabetes in Youth Study, the prevalence of DM in youth <20 years of age in 2001 in the United States was 1.82 cases per 1000 youth (0.79 of 1000 among youth between 0 and 9 years of age and 2.80 of 1000 among youth between 10 and 19 years of age). Non-Hispanic white youth had the highest prevalence (1.06 of 1000) in the younger group. Among youths between 10 and 19 years of age, black youth (3.22 of 1000) and non-Hispanic white youth (3.18 of 1000) had the highest rates, followed by American-Indian youth (2.28 of 1000), Hispanic youth (2.18 of 1000), and Asian/Pacific-Islander youth (1.34 of 1000). Among younger children, type 1 DM accounted for ≥80% of DM; among older youth, the proportion of type 2 DM ranged from 6% (0.19 of 1000 for non-Hispanic white youth) to 76% (1.74 of 1000 for American-Indian youth). This translates to 154 369 youth with physician-diagnosed DM in 2001 in the United States, for an overall prevalence estimate for DM in children and adolescents of approximately 0.18%.[1]

Abbreviations Used in Chapter 13

AI/AN	American Indian/Alaska Native
AHRQ	Agency for Healthcare Research and Quality
AMI	acute myocardial infarction
ARIC	Atherosclerosis Risk in Communities study
ARR	attributable risk ratio
BMI	body mass index
BP	blood pressure
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CI	confidence interval
CVD	cardiovascular disease
DBP	diastolic blood pressure
DM	diabetes mellitus
FHS	Framingham Heart Study
HbA_{1c}	glycosylated hemoglobin
HR	hazard ratio
ICD	International Classification of Diseases
IHS	Indian Health Service
kg/m^2	kilograms per square meter
LDL	low-density lipoprotein
mg/dL	milligrams per deciliter
MI	myocardial infarction
mm Hg	millimeters of mercury
mmol/L	millimoles per liter
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
NIDDK	National Institute of Diabetes and Digestive and Kidney Diseases
NIH	National Institutes of Health
OR	odds ratio
RR	relative risk
SBP	systolic blood pressure

Adults

- Among Americans ≥20 years of age, 9.6% have DM, and among those ≥60 years of age, 21% have DM. Men ≥20 years of age have a slightly higher prevalence (11%) than women (9%). Among non-Hispanic whites ≥20 years of age, 9% have DM; the prevalence of DM among non-Hispanic blacks in this age range 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.[2]
- The prevalence of DM increased by 8.2% from 2000 to 2001. Since 1990, the prevalence of those diagnosed with DM increased 61%.[3]
- On the basis of 2006 BRFSS (CDC) data, the prevalence of adults who reported ever having been told by a doctor that they have DM was 7.5%. West Virginia had the highest prevalence (12.1%), and Colorado had the lowest (5.3%).[4]
- The CDC analyzed data from 1994 to 2004 collected by the Indian Health Service (IHS), which indicated that the age-adjusted prevalence per 1000 population of DM increased 101.2% among American-Indian/Alaska-Native adults <35 years of age (from 8.5% to 17.1%). During this time period, the prevalence of diagnosed DM was greater among females than males in all age groups.[5]
- Data from NHANES (NCHS) show a disproportionately high prevalence of DM in non-Hispanic blacks and Mexican Americans compared with non-Hispanic whites, as shown in Table 13-1.[6]
- BRFSS (CDC) data from 1998 to 2002 in selected areas showed that DM disproportionately affects Hispanics in the United States and Puerto Rico. Hispanics were twice as likely to have DM as were non-Hispanic whites of similar age (9.8% versus 5.0%).[8]
- Data from NHANES 1999–2002 (NCHS) showed the prevalence of diagnosed DM in adults ≥65 years of age to be 15.3%. The prevalence of undiagnosed DM was 6.9%. This represents about 5.4 million and 2.4 million older individuals, respectively.[9]
- Type 2 DM accounts for 90% to 95% of all diagnosed cases of DM in adults.[10] In Framingham, Mass, 99% of DM is type 2.[11]
- The prevalence of DM 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 DM is projected to rise from 171 million in 2000 to 366 million in 2030.[12]
- On the basis of projections from NHANES/NCHS studies between 1984 and 2004, the total prevalence of DM in the

United States is expected to more than double from 2005 to 2050 (from 5.6% to 12.0%) in all age, sex, and race/ethnicity groups. Increases are projected to be largest for the oldest age groups (for instance, by 220% among those between 65 and 74 years of age and 449% among those 75 years of age). DM prevalence is projected to increase by 99% among non-Hispanic whites, by 107% among non-Hispanic blacks, and by 127% among Hispanics. The age/race/ethnicity group with the largest increase is expected to be blacks ≥75 years of age (increase of 606%).[13]

Incidence

Youth

- In the SEARCH for Diabetes in Youth Study, the incidence of DM in youth overall was 24.3 per 100 000 person-years. Among children <10 years of age, most had type 1 DM, regardless of race/ethnicity. The highest rates of incident type 1 DM were observed in non-Hispanic white youth (18.6, 28.1, and 32.9 per 100 000 person-years for age groups of 0 to 4, 5 to 9, and 10 to 14 years, respectively). Overall, type 2 DM was relatively infrequent, with the highest rates (17.0 to 49.4 per 100 000 person-years) seen among 15- to 19-year-old minority groups.[14]

Adults

- One and a half million new cases of DM were diagnosed in people ≥20 years of age in 2005.[2]
- Data from Framingham, Mass, indicate a doubling in the incidence of DM over the past 30 years, most dramatically during the 1990s. Among adults 40 to 55 years of age in each decade of the 1970s, 1980s, and 1990s, the age-adjusted 8-year incidence rates of DM were 2.0%, 3.0%, and 3.7% among women and 2.7%, 3.6%, and 5.8% among men, respectively. Compared with the 1970s, the age- and sex-adjusted OR for DM was 1.40 in the 1980s and 2.05 in the 1990s (P for trend=0.0006). Most of the increase in absolute incidence of DM occurred in individuals with a BMI ≥30 kg/m^2 (P for trend=0.03).[15]

Mortality

DM mortality—73 138. Total-mention mortality—225 400.

- The 2004 overall underlying cause death rate from DM was 24.5. Death rates were 26.2 for white males, 51.3 for black males, 19.2 for white females, and 45.3 for black females.[16]
- Data from the National Diabetes Information Clearinghouse, NIDDK, NIH:
  - — At least 65% of people with DM die of some form of heart disease or stroke.
  - — Heart disease death rates among adults with DM are 2 to 4 times higher than the rates for adults without DM.[17]
- FHS/NHLBI data show that having DM significantly increased the risk of developing CVD (HR, 2.5 for women and 2.4 for men) and of dying when CVD was present (HR, 2.2 for women and 1.7 for men). Diabetic men and women ≥50 years of age lived an average of 7.5 and 8.2 years less than their nondiabetic equivalents. The differences in life expectancy free of CVD were 7.8 and 8.4 years, respectively.[18]

Awareness

- The NIDDKD estimates that 20.8 million Americans (7% of the population) have DM and that about 30% are unaware of the diagnosis.[2]
- Analysis of NHANES/NCHS data from 1988–1994 to 1999–2002, in adults ≥20 years of age, showed that one third of those with DM did not know they had it. Although the prevalence of diagnosed DM has increased significantly over the past decade, the prevalences of undiagnosed DM and impaired fasting glucose have remained relatively stable. Minority groups remain disproportionately affected.[19]

Aftermath

- Although the exact date of DM onset can be difficult to determine, duration of DM 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 and the risk for CHD death was 1.86 times higher (95% CI, 1.17 to 2.93) for each 10-year increase in duration of DM.[20]
- DM increases the risk of stroke, with the RR ranging from 1.8 to almost 6.0.[21]
- Ischemic stroke patients with DM are younger, more likely to be black, and more likely to have hypertension, MI, and high cholesterol than are nondiabetic patients. DM increases ischemic stroke incidence at all ages, but this risk is most prominent before 55 years of age in blacks and before 65 years of age in whites.[22]
- On the basis of data from the CDC Diabetes Surveillance System, 1997–2003[23]:
  - — In 2003, the age-adjusted prevalence of any self-reported cardiovascular condition among persons with DM ≥35 years of age was 38.7% for white men, 30.7% for white women, 31.3% for black men, 28.9% for black women, 29.9% for Hispanic men, and 23.7% for Hispanic women.
  - — In 2003, the self-reported prevalence of any cardiovascular condition was 27.8% among persons 35 to 64 years of age, 48.0% among persons 65 to 74 years of age, and 58.0% among persons ≥75 years of age.
  - — In 2003, among persons with DM ≥35 years of age, the age-adjusted prevalence of self-reported CHD, angina, or MI was >2 times that of self-reported stroke (22.3% versus 9.0%).
- Statistical modeling of the use and effectiveness of specific cardiac treatments and of changes in risk factors between 1980 and 2000 among US adults 25 to 84 years of age showed that the age-adjusted death rate for CHD fell from 543 to 267 deaths per 100 000 population among men and from 263 to 134 deaths per 100 000 population among women. About 47% of this decrease was attributed to treatments, and about 44% was attributed to changes in risk

factors, although reductions were partially offset by increases in BMI and the prevalence of DM, which accounted for an increased number of deaths (8% and 10%, respectively).[24]

— In 2003, 5.2 million persons ≥35 years of age with DM reported being diagnosed with a cardiovascular condition, 3.5 million were diagnosed with CHD (ie, self-reported CHD, angina, or MI), and 1.5 million reported being diagnosed with a stroke.

- Data from the ARIC study of the NHLBI found that DM was a weaker predictor of CHD in black than in white persons.[25]
- Data from Framingham, Mass, show that despite improvements in CVD morbidity and mortality, DM continues to elevate CVD risk. Participants between 45 and 64 years of age from the FHS original and offspring cohorts who attended examinations in 1950–1966 ("earlier" time period) and 1977–1995 ("later" time period) were followed up for incident MI, CHD death, and stroke. Among participants with DM, 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% decline. HRs for DM as a predictor of incident CVD were not significantly different in the earlier (risk factor–adjusted HR, 2.68, 95% CI 1.88–3.82) versus later (HR, 1.96, 95% CI 1.44–2.66) periods.[26] Thus, although there was a 50% reduction in the rate of incident CVD events among adults with DM, the absolute risk of CVD remained 2-fold greater than among persons without DM.[26]

— Data from these earlier and later time periods in Framingham also suggest that the increasing prevalence of DM is leading to an increasing rate of CVD, resulting in part from CVD risk factors that commonly accompany DM. The age- and sex-adjusted HR for DM as a CVD risk factor was 3.0 in the earlier time period and 2.5 in the later time period. Because the prevalence of DM has increased over time, the population-attributable risk for DM as a CVD risk factor increased from 5.4% in the earlier time period to 8.7% in the later time period (attributable risk ratio [ARR], 1.62; $P=0.04$). Adjustment for CVD risk factors (age, sex, hypertension, current smoking, high cholesterol, and obesity) weakened this ARR to 1.5 ($P=0.12$).[27]

- Other studies show that the increased prevalence of DM 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 show increases in all-cause and cause-specific mortality between 1990 and 2000, as well as annual hospitalization rates for DM and its complications among patients hospitalized with acute MI (AMI) and/or DM. During this decade, all-cause and cause-specific mortality rates declined, but not for patients with DM; rates increased 61% and 52% for diabetic men and women, respectively, as did hospitalization rates for DM and its complications. The percentage of all AMIs occurring in patients with DM increased from 21% to 36%, and the absolute number more than doubled, from 2951 to 6048. Although hospital days for AMI fell overall, for those with DM, they increased 51% (from 34 188 to 51 566). These data suggest that increases in DM rates threaten the long-established nationwide trend toward reduced coronary artery events.[28]
- In an analysis of provincial health claims data for adults living in Ontario, Canada, between 1992 and 2000, the rate of patients admitted for AMI and stroke fell to a greater extent in the diabetic than the nondiabetic population (AMI: −15.1% versus −9.1%, $P=0.0001$; stroke: −24.2% versus −19.4%, $P=0.0001$). Diabetic patients experienced similar reductions in case fatality rates related to AMI and stroke as those without DM (−44.1% versus −33.2%, $P=0.1$; 17.1% versus 16.6%, $P=0.9$, respectively) and similar comparable declines in all-cause mortality. Over the same period, the number of DM cases increased by 165%, translating to a marked increase in the proportion of CVD events occurring among patients with DM: AMI, 44.6%; stroke, 26.1%; AMI deaths, 17.2%; and stroke deaths, 13.2%.[29]
- In the same dataset, the transition to a high-risk category (an event rate equivalent to a 10-year risk of ≥20% or an event rate equivalent to that associated with previous MI) occurred at a younger age for men and women with DM than for those without DM (mean difference, 14.6 years). For the outcome of AMI, stroke, or death from any cause, diabetic men and women entered the high-risk category at 47.9 and 54.3 years of age, respectively. The data suggest that DM confers a risk equivalent to aging 15 years. In North America, diverse data show lower rates of CVD among diabetics, but as the prevalence of DM has risen, so has the absolute burden of CVD, especially among middle-aged and older individuals.[30]

Risk Factors

- A meta-analysis examined the beneficial effect of standard interventions to prevent CVD in patients with DM. 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.[31]
- Data from the 2004 National Healthcare Disparities Report (AHRQ, US Department of Health and Human Services) found that only about one third of adults with DM received all 5 interventions recommended for comprehensive DM care in 2001. The proportion receiving all 5 interventions

was lower among blacks than whites and lower among Hispanics than non-Hispanic whites.[32]

— 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.[32]

- Between NHANES III 1988–1994 (NCHS) and NHANES 1999–2002 (NCHS), considerable differences were found among ethnic groups in glycemic control rates among adults with type 2 DM. 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%.[33]
- Analysis of NHANES 1999–2000 (NCHS) data also shows poor control of risk factors in US adults with DM. Only 37.0% of participants achieved the target HbA_{1c} level of <7.0%, and 37.2% of participants were above the recommended "take action" HbA_{1c} level of >8.0%. Only 35.8% of participants achieved an SBP <130 mm Hg and a DBP <80 mm Hg, and 40.4% had hypertensive BP levels (SBP ≥140 or DBP ≥90 mm Hg). More than half (51.8%) of the participants had total cholesterol levels ≥200 mg/dL. In total, only 7.3% of adults with DM in NHANES 1999–2000 (NCHS) attained recommended goals of HbA_{1c} level <7%, BP <130/80 mm Hg, and total cholesterol level <200 mg/dL.[34]
- In one large academic medical center, outpatients with type 2 DM 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, SBP, or LDL cholesterol levels exceeded recommended treatment goals; and who had been prescribed greater-than-starting-dose therapy if these values were above 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 who received any drug therapy was greater for above-goal HbA_{1c} (92%) than for above-goal SBP (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 than were those who had above-goal SBP (62%) and LDL cholesterol levels (13%; $P<0.0001$).[35]

— Data from the same academic medical center also showed that CVD risk factors among women with DM were managed less aggressively than among men with DM. Women were less likely than men to have HbA_{1c} <7% (without CHD: adjusted OR for women versus men, 0.84, $P=0.005$; with CHD: 0.63, $P<0.0001$). Women without CHD were less likely than men to be treated with lipid-lowering medication (0.82; $P=0.01$) or, when treated, to have LDL cholesterol levels <100 mg/dL (0.75; $P=0.004$) and were less likely than men to be prescribed aspirin (0.63; $P<0.0001$). Women with DM and CHD were less likely than men to be prescribed aspirin (0.70; $P<0.0001$) or, when treated for hypertension or hyperlipidemia, were less likely to have BP levels <130/80 mm Hg (0.75; $P<0.0001$) or LDL cholesterol levels <100 mg/dL (0.80; $P=0.006$).[36]

Cost

In 2002, the direct and indirect cost attributable to DM was $132 billion.[37] In one managed healthcare system, >25% of the excess cost of DM was due to CVD complications.[38]

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Table 13-1. Diabetes

Population Group	Prevalence of Physician-Diagnosed DM, 2005 Age ≥20 y	Prevalence of Undiagnosed DM, 2005 Age ≥20 y	Prevalence of Prediabetes, 2005 Age ≥20 y	Incidence of Diagnosed DM Age ≥20 y	Mortality (DM), 2004‡ All Ages	Hospital Discharges, 2005 All Ages	Cost, 2002§
Both sexes	15 100 000 (7.3%)	6 000 000 (2.8%)	59 700 000 (27.9%)	1 500 000	73 138	585 000	$132 billion
Males	7 600 000 (7.3%)	3 700 000 (3.6%)	34 800 000 (33.5%)	...	35 267 (48.2%)*	283 000	...
Females	7 500 000 (6.8%)	2 300 000 (2.0%)	24 900 000 (22.6%)	...	37 871 (51.8%)*	302 000	...
NH white males	6.7%	3.2%	34.3%	...	28 629	...	...
NH white females	5.6%	1.7%	21.6%	...	29 458	...	...
NH black males	10.7%	1.7%	23.1%	...	5565	...	...
NH black females	13.2%	2.3%	20.5%	...	7269	...	...
Mexican-American males	11.0%	1.1%	37.5%	...	...	...	...
Mexican-American females	10.9%	3.1%	22.6%	...	...	...	...
Hispanic or Latino† age ≥18 y	9.8%	...	...	...	...	...	...
Asian† age ≥18 y	6.5%	...	...	...	...	...	...
AI/AN† age ≥18 y	13.6%	...	...	...	...	...	...

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

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

†NHIS.[7] Data are age-adjusted estimates for Americans ≥18 years of age.

‡Mortality data are for whites and blacks and include Hispanics.

§CDC; National Diabetes Fact Sheet.

Sources: Prevalence: NHANES 1999–2004, (NCHS), and NHLBI; percentages for racial/ethnic groups are age adjusted for Americans ≥20 years of age. Estimates from NHANES 1999–2004 (NCHS) applied to 2005 population estimates ≥20 years of age. Incidence: NIDDK estimates. Mortality: NCHS. These data represent underlying cause of death only. Hospital discharges: NHDS, NCHS; data include those inpatients discharged alive, dead, or status unknown.

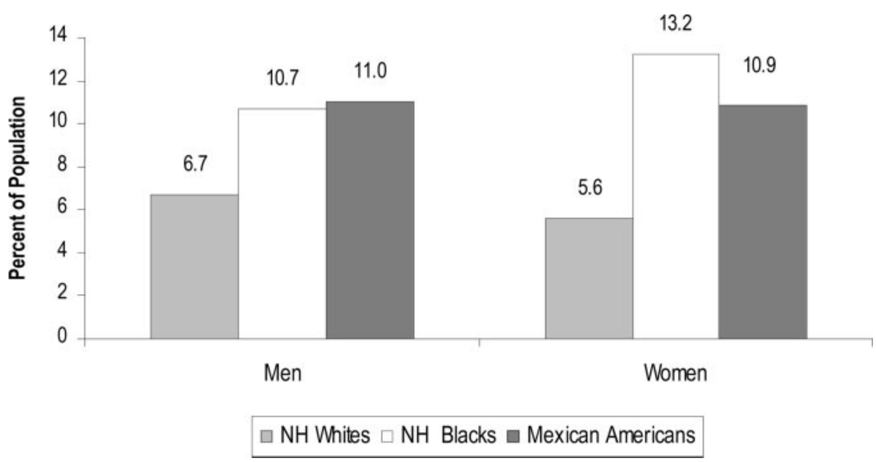

Chart 13-1. Prevalence of physician-diagnosed DM in adults ≥18 years of age by race/ethnicity and sex (NHANES: 1999–2004). Source: NCHS and NHLBI.

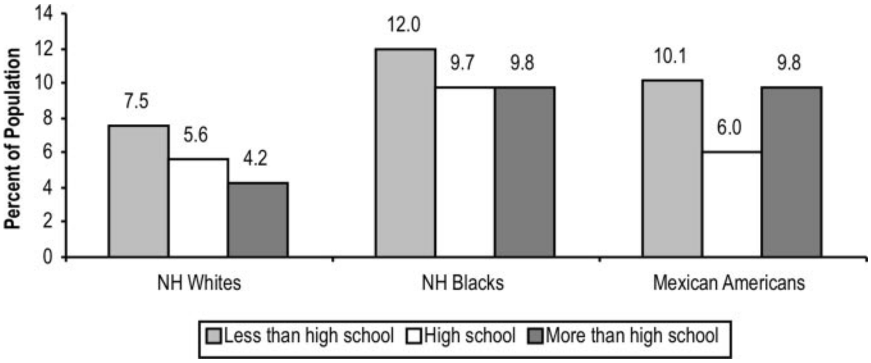

Chart 13-2. Prevalence of physician-diagnosed type 2 DM in adults ≥18 of age by race/ethnicity and years of education (NHANES: 1999–2004). Source: NCHS and NHLBI.

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 and/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 of age; the age group with the highest prevalence rate is 70 to 74 years of age.

- The incidence of reported ESRD has almost doubled in the past 10 years.[1]
- In 2004, 104 364 new cases of ESRD were reported.[1]
- The number of persons treated for ESRD increased from 68 757 in 1994 to 102 356 in 2004; this translates to an increase of 261.3 per million population in 1994 to 348.6 in 2004.[2]
- Data from the US Renal Data System show that in 2004, 84 252 patients died from ESRD.[1]
- In 2004, mortality rates for those ≥65 years of age receiving dialysis were 7 times greater than those of the general Medicare population.[2]
- Nearly 17 000 kidney transplantations were performed in 2004.[1]
- Diabetes continues to be the most common reported cause of ESRD, followed by hypertension and glomerulonephritis.[2] These 3 diseases accounted for 80% of cases of ESRD between 1994 and 2004.[2]
- From 1994 to 2004, ESRD attributed to glomerulonephritis decreased among all races analyzed.[2]
- ESRD attributed to diabetes or hypertension decreased for American Indians/Alaska Natives and Asians/Pacific Islanders but not for whites or blacks from 1999 to 2004.[2] This decrease is particularly impressive given the increasing prevalence of diabetes among American Indians/Alaska Natives.
- From 1994 to 2004, ESRD attributed to glomerulonephritis was highest among blacks.[2]
- The CDC analyzed 1990–2002 data from the US Renal Data System, which showed that diabetes is the leading cause of ESRD, accounting for 44% of new cases in 2002. Although new cases of ESRD-attributed diabetes mellitus increased overall, the incidence of ESRD-attributed diabetes mellitus among persons with diabetes is not increasing among blacks, Hispanics, men, and people 65 to 74 years of age, and it is declining in people <65 years of age, women, and whites.[3]
- Between 1996 and 1997, 3.2% of the Medicare population had a diagnosis of CKD, representing 63.6% of people who progressed to ESRD after 1 year.[4]
- Data from a large HMO population reveal that among adults with a GFR >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 in this same patient population, BP-associated risks were greater in men than in women and in blacks than in whites.[5] (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.[6] (Also see Table 14-2.)

Abbreviations Used in Chapter 14

BMI	body mass index
BP	blood pressure
CHF	congestive heart failure
CKD	chronic kidney disease
CVD	cardiovascular disease
eGFR	estimated glomerular filtration rate
ESRD	end-stage renal disease
GFR	glomerular filtration rate
HDL	high-density lipoprotein
HBP	high blood pressure
HMO	health maintenance organization
JNC	Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure
K/DOQI	Kidney Disease Outcome Quality Initiative
LDL	low-density lipoprotein
mL/min per 1.73 m^2	first morning urine protein/creatinine ratio
NHANES	National Health and Nutrition Examination Survey
NKF	National Kidney Foundation
RR	relative risk

Age, Sex, Race, and Ethnicity

- Children with pediatric ESRD have high transplantation rates. Time to first transplant appears to be increasing. From 1996 to 2000, 75% of children 10 years of age or younger and 90.3% of those over 10 years of age received a transplant within 5 years of initiation; from 2001 to 2005, the numbers fell to 70% and 79%, respectively.[7]
- The median age of the population with ESRD 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).[8] 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.[1]
- Without treatment, ESRD is fatal. Even with dialysis treatment, 20% of ESRD patients die yearly.[9]
- Expenditures for ESRD totaled $27.3 billion in 2003.[10]
- The percentage of hemodialysis patients with a urea reduction ratio of ≥65 increased from 74% in 1996 to 90% in 2002.[9]

Chronic Kidney Disease

Prevalence

- CKD is a serious health condition and a worldwide public health problem. The incidence and prevalence of CKD are increasing in the United States and are associated with poor outcomes and a very high cost to our healthcare system. Controversy exists over whether CKD is itself an independent risk factor for incident CVD, but it is clear that persons with CKD, as well as those with ESRD, represent a population at very high CVD risk. The US Renal Data System estimates that by 2010, 650 000 Americans will require treatment for kidney failure,[11,12] representing a 60% increase from those who received such treatment in 2001.[13]
- The NKF K/DOQI developed guidelines providing a standardized definition for CKD in 2002. The most recent US prevalence estimates of CKD, with the use of K/DOQI guidelines, come from NHANES 1999–2004 (NCHS) in adults ≥20 years of age.[14]
- The prevalence of CKD (stages I to V)[1]* is 16.8%. This represents an increase from the 14.5% prevalence estimate from NHANES 1988–1994 (NCHS) (recalculated).
- The prevalence of GFR ≥90 mL/min per 1.73 m^2 with kidney damage (ie, presence of albuminuria) is 5.7%.
- The prevalence of stage II CKD (eGFR 60 to 89 mL/min per 1.73 m^2 with kidney damage) is 5.4%.
- The prevalence of stage III CKD (eGFR 30 to 59 mL/min per 1.73 m^2) is 5.4%.
- The prevalence of stages IV/V CKD (eGFR <29 mL/min per 1.73 m^2) is 0.4%.

Demographics

- The prevalence of CKD rose as age increased, as follows[14]:
  - — 8.5% for those 20 to 39 years of age;
  - — 12.6% for those 40 to 59 years of age;
  - — 39.4% for those ≥60 years of age.
- CKD was more prevalent among those with less than a high school education (22.1%) than among those with at least a high school education (15.7%).[14]
- CKD prevalence was greater among those with diabetes (40.2%), hypertension (24.6%), and cardiovascular disease (28.2%) than among those without these chronic conditions.[14]
- The prevalence of CKD was higher among Mexican Americans (18.7%) and non-Hispanic blacks (19.9%) than among non-Hispanic whites (16.1%).[14] This disparity was most evident for those with stage I CKD; non-Hispanic whites had a CKD prevalence of 4.2%, compared with prevalences among Mexican Americans and non-Hispanic blacks of 10.2% and 9.4%, respectively.

*CKD stages I and II represent "CKD indicators" and not actual CKD. The presence of persistent albuminuria from 2 urine samples is required to make a confirmatory diagnosis of kidney damage, whereas the presence of albuminuria in 1 sample suggests that kidney damage is present.

Risk Factors

- Many traditional CVD risk factors are also risk factors for CKD, including older age, male sex, hypertension, diabetes, elevated LDL, low levels of HDL, smoking, physical inactivity, menopause, and family history of CVD.
- Other risk factors include systemic conditions such as autoimmune diseases, systemic infections, and drug exposure as well as anatomically local conditions such as urinary tract infections, urinary stones, lower urinary tract obstruction, and neoplasia. Even after adjustment for these risk factors, excess CVD risk remains.[15]
- Many clinical risk factors for CKD are the same as those for CVD.
- Proteinuria is a strong independent risk factor for decline in eGFR, regardless of diabetes status, and is associated with many of the same CVD risk factors as those for CKD.[16,17]

ESRD/CKD and CVD

- CVD is the leading cause of death for those with ESRD.
  - — CVD mortality is 5 to 30 times higher in dialysis patients than in subjects from the general population of the same age, sex, and race.[18,19]
  - — Individuals with less severe forms of kidney disease are also at significantly increased risk.[18]
- Studies from a broad range of cohorts demonstrate an association between reduced eGFR and elevated risk of CVD, CVD outcomes, and all-cause mortality,[20–26] but data are inconsistent with regard to whether these elevated risks are independent of other known major CVD risk factors
- Any degree of albuminuria, starting below the microalbuminuria cut point, has been shown to be an independent risk factor for cardiovascular events, CHF hospitalization, and all-cause mortality in a wide variety of cohorts.[27–31]
- A number of consensus documents, including statements from the NKF Task Force[32] and American Heart Association (2003),[18] have indicated that persons with CKD should be considered part of the highest-risk group for CVD.

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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	1.00 (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)
18.5–24.9 (normal weight)	1.00 (Reference)
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 a cluster of risk factors for CVD and type 2 DM. Several different definitions for MetS are in use; in the United States, the National Cholesterol Education Program Adult Treatment Panel III (ATP III) definition has been most commonly used. By this definition, MetS is diagnosed when ≥3 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

Adults

On the basis of National Cholesterol Education Program ATP III criteria:

- On the basis of 1988–1994 data from NHANES III (NCHS), 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 20 to 29 years of age to 43.5% for people 60 to 69 years of age and 42.0% for those ≥70 years of age.[2]
  — The age-adjusted prevalence is similar for men (24.0%) and women (23.4%).[2]
  — 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]
  — Mexican Americans have the highest age-adjusted prevalence of MetS (31.9%). The lowest prevalences are among whites (23.8%), blacks (21.6%), and people reporting as "other" race or ethnicity (20.3%).[2]
  — Among blacks, women had a prevalence approximately 57% higher than that of men. Among Mexican Americans, women had a prevalence approximately 26% higher than that of men.[2]

Children/Adolescents

- With a pediatric definition based closely on ATP III, as well as data from NHANES III (NCHS), an estimated 1 in 10 (9.2%) US adolescents between 12 and 19 years of age 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]
- MetS categorization in adolescents is not stable. Approximately half of 1098 adolescent participants in the Princeton School District Study diagnosed with pediatric ATP III MetS lost the diagnosis over 3 years of follow-up.[5]
- Analysis of data from the CARDIA study found that young adults who maintained stable BMI over time had minimal progression of risk factors and lower incidence of MetS regardless of baseline BMI.[6]

Risk

- According to NHANES (NCHS) 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 DM had the highest level of risk (Chart 15-1).[7]
- In the ARIC (NHLBI) study of 12 089 black and white middle-aged individuals, MetS (as determined by ATP III criteria) was present in approximately 23% of individuals without DM or prevalent CVD at baseline. Over an average of 11 years of follow-up, 879 incident CHD events and 216 ischemic stroke events occurred. Men and women with MetS were respectively about 1.5 and 2 times more likely to develop CHD after adjustment for age, smoking, LDL cholesterol, and race or ARIC center.[8]
- In the FHS (NHLBI), 3323 middle-aged adults (who were free of CVD and DM at baseline in 1989–1993) were followed up for 8 years for the development of new CVD, CHD, and type 2 DM. The prevalence of ATP III MetS at baseline 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 33.9% (after direct adjustment to the baseline age), an 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 23.6% (an age-adjusted 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

Abbreviations Used in Chapter 15

ARIC	Atherosclerosis Risk In Communities study
ATP III	Adult Treatment Panel III of the National Cholesterol Education Program
BMI	body mass index
BP	blood pressure
CARDIA	Coronary Artery Risk Development In young Adults study
CHD	coronary heart disease
CI	confidence interval
cm	centimeter
CVD	cardiovascular disease
DM	diabetes mellitus
FHS	Framingham Heart Study
HDL	high-density lipoprotein
LDL	low-density lipoprotein
MetS	metabolic syndrome
mg/dL	milligrams per deciliter
mm Hg	millimeters of mercury
NHANES	National Health and Nutrition Examination Survey
RR	relative risk

10.81 for DM. 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 DM (RR 6.90, 95% CI 4.34 to 10.94). Population-attributable risk estimates associated with MetS for CVD, CHD, and DM were 34%, 29%, and 62% in men and 16%, 8%, and 47% in women, respectively. There was a strong positive association between the number of MetS traits and risk of subsequent CHD, CVD, and DM. The data show that MetS is a far stronger risk factor for DM than for CVD and that the number of risk factors is a more important risk determinant than the presence or absence of MetS.[9]

- Despite increased risk associated with MetS, data from the ARIC (NHLBI) study showed that by comparison of receiver operating characteristic curves, a diagnosis of MetS did not materially improve CHD risk prediction beyond the level achieved by the Framingham risk score.[8]
- Population-based data from the United Kingdom compared ATP III MetS with the Framingham risk score as predictors of CHD, stroke, and type 2 DM in men between 40 and 59 years of age with no history of CHD, stroke, or DM who were followed up for a period of 20 years. The probability of developing CVD or DM over 20 years increased from 11.9% in those with no MetS traits to 31.2% in those with 3 traits and 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 DM. 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 DM, and 0.66 versus 0.55 for stroke ($P<0.001$ for all). As in the ARIC (NHLBI) data, 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 DM 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.[10,11]

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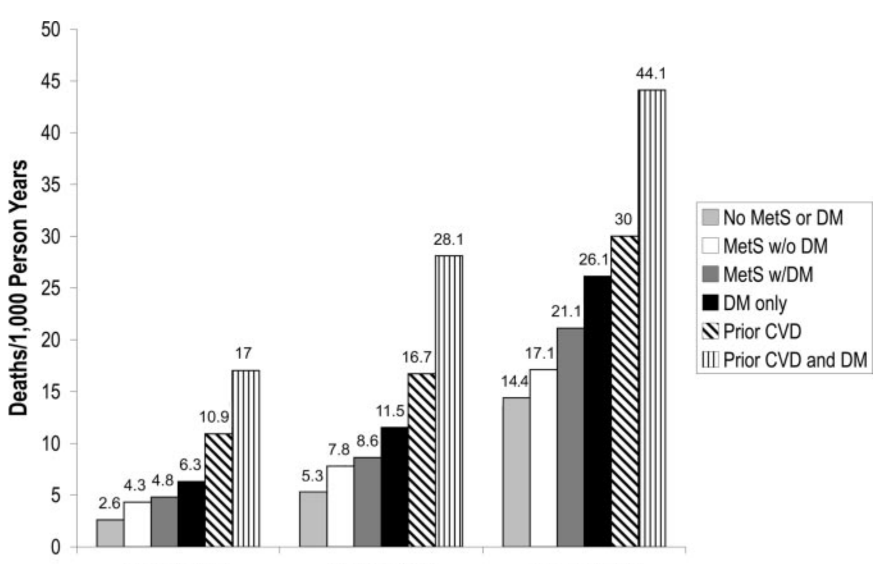

Chart 15-1. Mortality rates in US adults, 30 to 75 years of age, with MetS, with and without DM and preexisting CVD. (NHANES II 1976–1980 Follow-Up Study [average of 13 years of follow-up]). Source: Malik et al.[7] w/o indicates without.

16. Nutrition

SeeTable 16-1.

- The Economic Research Service of the US Department of Agriculture (USDA) suggests that average daily calorie consumption in the United States increased 16%, or by 523 calories, between 1970 and 2003. 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 1999–2002, the mean age-adjusted total daily calories for people between 20 and 74 years of age increased from 2450 to 2634 calories for men and from 1542 to 1874 calories for women.[2]
- In 1999–2000, among children between 2 and 6 years of age, 20% had a good diet, 74% had a diet that needed improvement, and 6% had a poor diet. For those between 7 and 12 years of age, 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 1 and 19 years of age 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 portion sizes for:

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

- Analysis of data from the Minnesota Heart Survey found that age-adjusted mean Heart Disease Prevention Eating Index scores increased in both sexes during the past 2 decades, driven in particular by improvements in total grain, whole grain, total fat, saturated fatty acids, *trans*-fatty acids, and cholesterol intake. Energy balance, sodium intake, and fish intake were observed to change unfavorably or to stay at a low compliance level.[5]

Abbreviations Used in Chapter 16

BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CHS	Cardiovascular Health Study
CVD	cardiovascular disease
g	gram
kcal	kilocalories
mg	milligram
NCHS	National Center for Health Statistics
NHANES	National Health and Nutrition Examination Survey
PA	physical activity
μg	microgram
USDA	US Department of Agriculture

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, NCHS).
- 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, NCHS).
- The average daily percentages of calories from fat in the United States, are as follows, by population group[6]:

  — Non-Hispanic white: male, 33.9%; female, 32.0%.
  — Non-Hispanic black: male, 34.7%; female, 33.5%.
  — Other non-Hispanic: male, 33.4%; female, 31.7%.
  — Hispanic: male, 33.7%; female: 32.1%.

- When evaluated on the basis of age, the percentage of calories from fat does not appear to change until after 60 years of age[6]:

  — Ages 18 to 39 years: male, 34.4%; female, 32.4%.
  — Ages 40 to 59 years: male, 34.2%; female, 32.6%.
  — Age >60 years: male, 32.6%; female: 31.0%.

- From 1965 to 1994–1996, the proportion of fat calories from beef, pork, dairy products, and eggs fell from 50% to 33%; the proportion of fat calories from poultry increased from 4% to 7%; and calories from fruits and vegetables rose from 8% to 13%.[7]
- 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 gal in 1972–1976 to 8.2 gal in 1997 accounts for most of the reduction in saturated fat.[7]
- According to USDA data, in 2002, total meat consumption (red meat, poultry, and fish) amounted to 200 lb per person, 23 lb higher than the level in 1970. Each American consumed an average of 18 lb less red meat (mostly beef), 37 lb more poultry, and 4 lb more fish than in 1970.[1]
- Data from NHANES 1999–2002 (NCHS) showed that the mean percentage of calories from total fat was 33.0% for males and 33.2% for females.[2]
- Data from NHANES 1999–2002 (NCHS) showed that the mean percentage of calories from saturated fat was 10.8% for males and females.[2]

Cholesterol

- The average daily intake of dietary cholesterol in the United States is 265 mg. For males, the average is 307 mg, and for females, the average is 225 mg (NHANES 1999–2000 [NCHS]).[8]
- Average intakes of dietary cholesterol in the United States, by age and gender, are as follows[9]:

  — Men 19 to 30 years of age, 345 g; women 19 to 30 years of age: 210 g.
  — Men 31 to 50 years of age, 345 g; women 31 to 50 years of age: 219 g.
  — Men 51 to 70 years of age, 317 g; women 51 to 70 years of age: 208 g.

— Men ≥71 years of age, 267 g; women ≥71 years of age, 189 g.

Fiber

- The recommended daily intake of dietary fiber is 20 to 35 g/d for healthy adults. For children, the recommended daily intake is the child's age plus 5 g/d.[10]
- 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.[11]
- Despite USDA Food Pyramid recommendations to consume several daily servings of whole grains, in 1994–1996, intake of whole grains for children was ≤1 serving.[12]
- Most Americans consume <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.)[13]

Fruits/Vegetables

- In 2005, the CDC BRFSS found that in surveyed US adults ≥18 years of age, approximately 32.6% consumed fruit ≥2 times per day (28.7% of men and 36.4% of women), and 27.2% consumed vegetables ≥3 times per day (22.1% of men and 32.2% of women).[14]
- The highest proportion of adults who consumed fruits and vegetables ≥5 times a day were those ≥65 years of age, whites, college graduates, those actively engaged in leisure-time PA, and nonsmokers.[7]
- Analysis of data from the 2005 BRFSS of the CDC showed that in people ≥18 years of age, the percentages who consumed fruits and vegetables ≥5 times a day were[15]:

  — 19.5% for non-Hispanic white men and 28.8% for women.
  — 21.5% for non-Hispanic black men and 27.3% for women.
  — 20.7% for Hispanic men and 28.3% for women.
  — 24.2% for American Indian/Alaska Native men and 32.5% for women.
  — 25.1% for Asian/Pacific Islander men and 35.9% for women.

- From 1990 to 1996, the percentage of obese adults who consumed ≥5 servings of fruits and vegetables per day dropped from 16.8% to 15.4%.[7]
- Recent studies support the intake of up to 9 servings of fruits and vegetables per day.[16]
- In 2005, the percentages of students in grades 9 through 12 who reported eating fruits and vegetables ≥5 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 students (18.6%) to have eaten ≥5 servings per day. The percentage was higher among Hispanic female students (21.8%) than white female students (17.4%) and higher among black male (24.3%) and Hispanic male (24.5%) than white male (19.7%) students.[17]

- In 2005, in 15 "Steps" communities of the YRBS (CDC), the overall percentage of students in grades 9 through 12 who had eaten fruits and vegetables ≥5 times a day during the 7 days preceding the survey ranged from 14.8% to 19.9% (14.3% to 20.5% of male students and 13.3% to 19.2% of female students).[18]
- One third of children 19 to 24 months of age consumed no fruit, whereas 60% consumed baked desserts, 20% ate candy, and 44% drank sweetened beverages on a given day.[19]
- From 1994 to 1996, only 14% of children between 6 and 19 years of age met then-current USDA Food Pyramid recommendations for daily fruit intake (2 to 4 servings per day). Only 20% got enough vegetables (3 to 5 servings per day).[20]
- 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%.[21]

Costs

Each year, more than $33 billion in medical costs and $9 billion in lost productivity as a result of heart disease, cancer, stroke, and diabetes are attributed to poor nutrition.[22,23]

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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	NA*	2634*	1874*
Protein, % of calories	14.7%	14.9%	14.6%
Carbohydrate, % of calories	NA*	48.9%*	51.5%*
Total fat, % of calories	NA*	33.0%*	33.2%*
Saturated fat, % of calories	NA*	10.8%*	10.8%*
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.)

*NHANES (1999–2002), NCHS. Health, United States, 2006.

17. Quality of Care

See Tables 17-1 through 17-11.

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
ACS	acute coronary syndrome
AF	atrial fibrillation
AHA	American Heart Association
ARB	angiotensin receptor blocker
BMI	body mass index
BP	blood pressure
CAD	coronary artery disease
CHF	congestive heart failure
CMS	Centers for Medicare and Medicaid Services
CRUSADE	Can Rapid stratification of Unstable angina patients Suppress ADverse outcomes with Early implementation of the ACC/AHA guidelines
CVD	cardiovascular disease
d	days
DM	diabetes mellitus
DVT	deep vein thrombosis
GWTG	Get With The Guidelines
h	hours
HbA_{1c}	glycosylated hemoglobin
HEDIS	Health Plan Employer Data and Information Set
HF	heart failure
ICD	International Classification of Diseases
kg/m^2	kilograms per square meter
LDL	low-density lipoprotein
LVSD	left ventricular systolic dysfunction
mg/dL	milligrams per deciliter
mm Hg	millimeter of mercury
MI	myocardial infarction
min	minutes
NCDR	National Cardiovascular Data Registry
PCI	percutaneous coronary intervention
tPA	tissue plasminogen activator
TIA	transient ischemic attack
VHA	Veterans Health Administration

In addition, several studies over the past year demonstrated an association between adherence to guideline-recommended therapies and improved outcomes. These studies are highlighted below:

- From a survey of 365 hospitals, 6 strategies were identified as being associated with faster door-to-balloon times for patients presenting with ST-segment–elevation MI[3]:
  - — Emergency medicine physicians activate the cardiac catheterization laboratory (mean reduction in door-to-balloon time of 8.2 minutes).
  - — Staff arrive at the cardiac catheterization laboratory within 20 minutes of being paged (19.3 minutes).
  - — A single call to a central page operator is used to activate the laboratory (13.8 minutes).
  - — The emergency department activates the cardiac catheterization laboratory while the patient is en route to the hospital (15.4 minutes).
  - — An attending cardiologist is on site (14.6 minutes).
  - — Real-time data feedback is used for staff in the emergency department and cardiac catheterization laboratory (8.6 minutes).
- An observational analysis of 350 hospitals and 64 775 patients found that guideline-recommended treatments for ACS were strongly associated with improved patient outcomes.[4] Hospitals in the highest quartile of guideline adherence had lower in-hospital mortality rates (4.2%) than those in the lower quartiles (6.3%). Every 10% increase in composite adherence at a hospital was associated with an analogous 10% decrease in its patients' likelihood of in-hospital mortality.
- Over a 3-year period from 2002 through 2004, among 159 168 patients admitted with heart failure at 285 hospitals, there was a decrease in inotrope use, and improvements were made in providing discharge instructions, smoking cessation counseling, and left ventricular assessment and in β-blocker use.[5] During this same period of time, there was an improvement in clinical outcomes, including need for mechanical ventilation (5.3% to 3.4%), length of stay (reduced from a mean of 6.3 days to 5.5 days), and in-hospital mortality rate (from 4.5% to 3.2%).

ACS Quality-of-Care Measures

The following are indicators of quality of care for ACS, as measured by different national organizations or registries. The quality indicators that are similar across organizations/registries have been summarized in Table 17-1 below. Each of the organizations/registries focuses on specific populations among patients hospitalized for an ACS. For quality measures that are not common across each organization/registry, additional quality measures are listed in separate tables (Tables 17-2 through 17-5).

- The Veterans Health Administration collects national quality-performance data related to CVD, including acute MI and HF. Aggregate data from 158 Veterans Administration hospitals for the period between October 2006 and March 2007 are listed in Table 17-1 (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).

- As part of the Hospital Quality Alliance Program, data are collected by the CMS on quality-of-care indicators for conditions including acute MI and HF. The data presented in Table 17-1 were collected from eligible patients for hospital admissions between January 2006 and December 2006. Additional data can be obtained from the United States Department of Health & Human Services' "Hospital Compare" Web site.[6]
- 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. Data on treatment measures from the CRUSADE registry on 29 659 patients from 295 hospitals from January 1, 2006, through December 31, 2006, are listed in Table 17-1. 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.[7]
- "Get With The Guidelines on Coronary Artery Disease" (GWTG-CAD) is a national quality-improvement initiative of the AHA intended to help hospitals redesign systems of care to improve adherence to guidelines in patients admitted with a cardiovascular event. Table 17-1 summarizes performance on the selected quality-of-care indicators for CAD events. These were collected from 58 847 patients who were admitted to 315 hospitals participating in the GWTG-CAD program from January 1, 2006, through December 31, 2006.

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Table 17-1. ACS Quality-of-Care Measures

Acute MI	VHA Data	National Medicare and Medicaid Data	ACS Registry (CRUSADE) Data	AHA GWTG-CAD Data
Aspirin within 24 h of admission	97%	96%	97%	95%
Aspirin at discharge	98%	96%	96%*	94%†
β-Blockers within 24 h of admission	96%	93%	92%	NM
β-Blockers at discharge	98%	96%	94%*	92%†
Lipid-lowering medication at discharge	95%	NM	85%*	85%
ARB/ACE inhibitor at discharge for patients with left ventricular ejection fraction <40%	87%	86%	65%‡	80%
Adult smoking cessation advice/counseling	94%	96%	NM	94%†

VHA indicates Veterans Health Administration; NM, not measured; ARB, angiotensin receptor blocker; and ACE, angiotensin-converting enzyme.

VHA and National Medicare and Medicaid data are for patients with acute MI; ACS Registry (CRUSADE) data are for patients with non–ST-segment–elevation MI and unstable angina; AHA GWTG-CAD data are for patients admitted with a cardiovascular event. Values are percentages of patients who received the indicated treatment.

*Excludes patients with contraindication to medications, no discharge medications listed, transfer out, or death.

†Indicates 1 of the 5 key performance measures targeted in GWTG-CAD.

‡Includes patients with history of hypertension, DM, CHF, or left ventricular ejection fraction <40%.

Table 17-2. National VHA Data

Performance Measure	% of Patients
Acute MI	
LDL cholesterol assessment	96
Left ventricular ejection fraction assessment	95
Cholesterol—outpatient	
LDL <100 mg/dL after acute MI	68
Hypertension—outpatient	
Diagnosis of hypertension and BP ≤140/90 mm Hg	77

Table 17-3. National Medicare and Medicaid Data

Performance Measure for Acute MI	% of Patients
Fibrinolytic therapy received within 30 min of hospital arrival	71
Primary PCI received within 90 min of hospital arrival*	58
Inpatient mortality	7.0

*Data from third quarter of 2006 only.

Table 17-4. ACS Registry (CRUSADE)

	Overall		
Measure	% Usage	No. of Hospitals	No. of Patients
Acute medications* (within 24 h)			
Heparin, any	87	295	27 579
Glycoprotein IIb/IIIa inhibitor, any†	45	294	24 852
Discharge medications‡			
ACE inhibitor, overall	62	288	21 769
Lipid-lowering agent, recommended§	91	289	17 888
Procedures‖			
Cardiac catheterization, overall	85	294	24 271
Cardiac catheterization, within 48 h of arrival	69	294	24 271

*Excludes patients with contraindication to medications or no acute medications listed.

†Excludes patients with contraindication to medications only.

‡Excludes patients with contraindication to medications, no discharge medications listed, transfer out, or death.

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

‖Excludes patients with contraindication to cardiac catheterization.

Table 17-5. AHA GWTG-CAD Program

Performance Indicator	% of Inpatients
ACE inhibitor at discharge	69
ACE inhibitor at discharge for acute MI patients*†	73
Lipid therapy at discharge if LDL >100 mg/dL*†	89
BP control (to <140/90 mm Hg) at discharge	54
Referral to cardiac rehabilitation	73
Composite quality-of-care measure†	89

In-hospital mortality was 4.2% (excludes transfer out patients; if discharge status is missing, assume no), and mean length of hospital stay was 6.0 days (median 4.0 days) (2007 statistical update calculated same day admission and discharge as 1 day LOS; prior years calculated same day admission and discharge as 0 day LOS).

*Indicates 1 of the 5 key performance measures targeted in GWTG-CAD.

†The composite quality-of-care measure indicates performance on the provision of several elements of care (GWTG-CAD targets 5 key performance measures). 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). The other 3 GWTG-CAD performance measures are included in Table 17-1.

Table 17-6. HF Quality-of-Care Measures

Quality-of-Care Measure	VHA	National Medicare and Medicaid Data	AHA GWTG-HF Data*
Left ventricular ejection fraction assessment	99%	92%	94%†
ARB/ACE inhibitor at discharge for patients with LVSD	89%	85%	86%†
Complete discharge instructions	89%	68%	79%†
Adult smoking cessation advice/counseling	91%	90%	91%†
β-Blockers at discharge for patients with LVSD, no contraindications	NM	NM	89%†
Anticoagulation for AF or atrial flutter, no contraindications	NM	NM	67%

ARB indicates angiotensin receptor blocker; ACE, angiotensin converting enzyme; LVSD, left ventricular systolic dysfunction; and NM, not measured.

*GWTG-HF is a national quality improvement program of the AHA intended to help hospitals redesign systems of care to improve adherence to guidelines in patients admitted with HF. Data were collected for 35 576 patients admitted to 231 hospitals participating in the GWTG-HF program from January 1, 2006, through December 31, 2006. The composite quality-of-care measure was 88%. Mechanical ventilation was required in 1.8% of patients. In-hospital mortality was 3.2%, and mean length of hospital stay was 6.6 days (median 5.0 days).

†Indicates 1 of the 5 key performance measures targeted in GWTG-HF.

Table 17-7. AHA/American Stroke Association GWTG-Stroke Program

Performance Indicators	Percentage of Inpatients
Intravenous tPA in patients who arrived <2 h after symptom onset*	63
Intravenous tPA in patients who arrived <3 h after symptom onset	51
Documentation of ineligibility (why no tPA)	93
Rate of symptomatic brain hemorrhage after tPA	4.4
Antithrombotics <48 h after admission*	95
DVT prophylaxis by second hospital day*	83
Antithrombotics at discharge*	98
Anticoagulation for AF at discharge*	98
Therapy at discharge if LDL >100 mg/dL or on therapy at admission*	82
Counseling for smoking cessation*	84
Lifestyle changes recommended for BMI >25 kg/m^2	42
Composite quality-of-care measure	90

tPA indicates tissue plasminogen activator.

GWTG-Stroke is a national quality-improvement initiative of the AHA and American Stroke Association to help hospitals redesign systems of care to improve adherence to guidelines 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 141 449 clinically identified patients who were admitted to 778 hospitals participating in the GWTG-Stroke program from January 1, 2006, through December 31, 2006.

In-hospital mortality was 7.1%, and mean length of hospital stay was 6.5 days (median 5.0 days).

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

Table 17-8. Society of Thoracic Surgeons National Registry Data

Measure	2006 Data
No. of isolated coronary artery bypass procedures	156 128
No. of aortic valve procedures	16 330
No. of mitral valve procedures	4339
Unadjusted isolated coronary artery bypass operative mortality	2.1%
Unadjusted aortic valve operative mortality	3.2%
Unadjusted mitral valve operative mortality	5.6%
Mean postprocedure length of stay for isolated coronary artery bypass procedures	7.0 days
Mean postprocedure length of stay for aortic valve procedures	8.0 days
Mean postprocedure length of stay for mitral valve procedures	10.4 days

The Society of Thoracic Surgeons 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 258 417 procedures performed at 756 participating sites in 2006.

Table 17-9. National Committee for Quality Assurance HEDIS Measures of Care*

Measure	Commercial, %	Medicare, %	Medicaid, %
Acute MI			
β-Blocker prescription at discharge	97	94	86
β-Blocker persistence*	70	65	70
Hypertension			
BP ≤140/90 mm Hg	69	66	61
DM			
HbA_{1c} testing	88	89	76
HbA_{1c} >9.0%	30	24	49
Eye examination performed	55	67	49
LDL cholesterol screening	92	93	81
LDL cholesterol <130 mg/dL	68	72	51
LDL cholesterol <100 mg/dL	44	50	33
Monitoring nephropathy	55	60	49

The National Committee for Quality Assurance is a not-for-profit organization dedicated to improving healthcare quality. The clinical data for 2005 are based on voluntary reporting by >500 health plans. All clinical data are rigorously audited. The Health Plan Employer Data and Information Set (HEDIS) measures reported are a tool used by >90% of America's managed healthcare plans to measure performance on important dimensions of care and service. More information can be obtained at the National Committee for Quality Assurance Web site.[7]

*Received persistent β-blocker treatment for 6 months after acute MI hospital discharge.

Table 17-10. NCDR Cardiac Catheterization and PCI Data

Diagnostic Cardiac Catheterization (Without PCI in Same Laboratory Visit)	Overall (Mean)	Highest Quartile	Lowest Quartile
In-laboratory mortality	0.09%	0.00%	0.16% (90th percentile)
Major complications*	1.3%	0.2%	1.8%
PCI data			
Major complications, % of PCI patients*	2.3	0.9	3.0
Vascular complications, % of PCI patients†	2.1	0.9	2.6
Antiplatelet drug administration, % of PCI patients‡	97	99	96
Statin drug administration, % of PCI patients	85	92	80
Emergency coronary artery bypass graft, % of PCI patients	0.37	0.00	0.6
Average door-to-balloon time, min§	116	82	123
Percentage of patients with door-to-balloon time $\leq$90 min	59	74	46
Percentage of patients with door-to-balloon time $\leq$120 min	79	91	71
Risk-adjusted mortality rate, % of patients‖	1.0	0.59	1.4

NCDR indicates National Cardiovascular Data Registry.

The NCDR CathPCI registry, a partnership of the American College of Cardiology and the Society of Coronary Angiography and Intervention, is composed of diagnostic cardiac catheterizations and interventional (PCI) procedures harvested from participating facilities across the United States. Listed in this table are aggregated data from 369 137 diagnostic cardiac catheterizations (without PCI at same laboratory visit) and 303 709 PCI procedures performed on patients discharged in 2006 from 640 participating facilities. Only records with valid responses to indicators were considered, and not all procedures qualify for every indicator.

*Contrast media reaction, cardiogenic shock, cerebrovascular accident, CHF, cardiac tamponade, and renal failure.

†Bleeding at entry site (femoral approach), retroperitoneal bleeding, vascular access occlusion at entry site, peripheral embolization, vascular dissection, pseudoaneurysm, and arteriovenous fistula.

‡Proportion of PCI patients with stents receiving antiplatelet therapy such as clopidogrel or ticlopidine during admission.

§Elapsed time between entry to the facility and reperfusion of the affected coronary vessel for patients with acute MI treated with primary PCI.

‖PCI mortality rate adjusted by NCDR risk-adjustment algorithm.

Table 17-11. NCDR Data on Implantable Cardioverter Defibrillators

Implantable Cardioverter Defibrillator Procedures (Facilities That Submit All Procedures)	Overall (Mean)	Highest Quartile	Lowest Quartile
Percentage of patients experiencing any adverse event*	3.6	0.0	4.7
Lead dislodgement†	0.88%	0.00%	1.4%
β-Blocker medication during admission‡	85%	93%	80%
ACE inhibitor/ARB medication during admission§	78%	86%	71%
Percentage of patients receiving:			
Single-chamber implantable cardioverter defibrillator	26	...	...
Dual-chamber implantable cardioverter defibrillator	41	...	...
Biventricular implantable cardioverter defibrillator	33	...	...
Total length of stay, d	4.4	...	...
Postprocedure length of stay, d	2.0	...	...

In response to the CMS mandate to collect nationwide data on implantation of implantable cardioverter defibrillators, the NCDR ICD Registry, a partnership of the American College of Cardiology and the Heart Rhythm Society, was developed. Facilities may choose whether to submit all implantable cardioverter defibrillator procedures or a limited submission of CMS-mandated primary prevention procedures. Listed in the table are aggregated data from 77 780 implantable cardioverter defibrillator procedures submitted by 854 facilities from which the patient was discharged in 2006 and the submitting facility has chosen to report all their implantable cardioverter defibrillator procedures (ie, both primary and secondary prevention, Medicare and non-Medicare). Only records with valid responses to indicators were considered. These data are intended only for descriptive purposes; these measures are not intended as quality performance measures.

*Proportion of patients who had any adverse event, including death in hospital, cardiac arrest, drug reaction, cardiac perforation, cardiac valve injury, conduction block, coronary venous dissection, hematoma, lead dislodgement, hemothorax, pneumothorax, peripheral nerve injury, peripheral embolus, deep phlebitis, TIA, cerebrovascular accident/stroke, or MI.

†Proportion of lead dislodgements per procedure (may record >1 event per procedure).

‡Proportion of patients with left ventricular ejection fraction $\leq$40% admitted only for the procedure with any β-blocker prescribed at discharge, excluding patients with contraindications.

§Proportion of patients with left ventricular ejection fraction $\leq$40% with any ACE inhibitor or ARB prescribed at discharge, excluding patients with contraindications.

18. Medical Procedures

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

From 1979 to 2005, the total number of inpatient cardiovascular operations and procedures increased 484% to 6 989 000 annually (AHA computation).

- Data from men and women enrolled in Medicare from 1992 to 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]
  - — In 1992, 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.
  - — In 1992, 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.
  - — In 1992, 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.

Abbreviations Used in Chapter 18

ICD	International Classification of Diseases
MI	myocardial infarction
NCHS	National Center for Health Statistics
NHDS	National Hospital Discharge Survey
PCI	percutaneous coronary intervention
UNOS	United Network for Organ Sharing

Cardiac Catheterization

- From 1979 to 2005, the number of cardiac catheterizations increased 342% to 1 322 000 annually (AHA computation).
- The mean charge for patients hospitalized for diagnostic cardiac catheterization increased from $11 611 in 1993 to $26 910 in 2005. The total number of discharges was 604 502. The mean length of stay was 3.6 days.[2]

Coronary Artery Bypass Surgery

The NHDS (NCHS) estimates that in 2005, 469 000 coronary artery bypass procedures were performed on 261 000 patients in the United States.

Heart Transplantations

In 2006, 2192 heart transplantations were performed in the United States. There are 257 transplant hospitals in the United States, 135 of which perform heart transplantations.[3]

- Of these patients, 74.2% are male, and 68.4% are white; 24.7% are $<$35 years of age; 20.0% are between 35 and 49 years of age; and 55.3% are $\geq$50 years of age.
- As of June 15, 2007, the 1-year survival rate for males was 87.4%, and for females, it was 85.5%; the 3-year rates were 78.7% for males and 75.9% for females; and the 5-year rates were 72.3% for males and 67.6% for females.
- As of June 15, 2007, there were 2723 heart patients on the transplant waiting list.

Percutaneous Coronary Intervention

- In 2005, an estimated 1 265 000 PCI (previously referred to as percutaneous transluminal coronary angioplasty or PTCA) procedures were performed in the United States (NHDS, NCHS).
- In 2005, approximately 69% of PCI procedures were performed on men, and approximately 50% were performed on people $\geq$65 years of age (NHDS, NCHS).
- A follow-up study of 10.2 years, with a total observation time of 2067 person-years, investigated whether PCI with drug therapy improves long-term outcome in asymptomatic patients with silent ischemia after an MI and found that PCI reduced the long-term risk of major cardiac events.[4]

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Table 18-1. 2004 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 graft	$85 653	2.1%
PCI	$44 110	0.8%
Diagnostic cardiac catheterization	$25 322	0.9%
Pacemaker	$43 101	0.9%
Implantable defibrillator	$99 845	0.8%
Endarterectomy	$22 037	0.5%
Valves	$119 918	5.1%

Source: Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project.[2]

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: 2005 (in Thousands)

Operations/Procedures/ Patients (ICD-9 Code[s])	Sex			Age, y				Region†			
	Total	M	F	<15	15–44	45–64	≥65	Northeast	Midwest	South	West
Valves (35.1, 0.2, 0.99)‡	106	57	49	...	8§	34	59	24	22	35	25
Angioplasty (36.0)	1271	874	397	...	69	563	639	226	358	425	262
Total PCI (36.01, 0.02, 0.05, 0.06, 0.07)‖¶#	1265	872	394	...	68	559	637	224	358	421	262
PCI (36.01, 0.02, 0.05)	645	443	202	...	34	285	326	119	182	213	131
PCI with stents (36.06, 36.07)	620	429	192	...	34	275	311	105	176	208	131
Cardiac revascularization (bypass) (36.1–36.3)**											
Procedure	469	325	145	...	15	188	266	78	112	175	103
Patients	261	179	83	...	8§	102	151	45	61	98	58
Diagnostic cardiac catheterizations (37.2)	1322	808	513	11	104	548	659	238	316	509	259
Pacemaker devices (37.8)††	180	93	87	...	...	19	155	51	35	55	40
Implantable defibrillators (37.94–0.99)	91	67	24	...	7§	34	50	19	28	28	16
Endarterectomy (38.12)	103	62	42	...	...	21	82	18	20	46	20
Open-heart surgery‡‡	699	453	245	25	42	255	377	137	162	252	147
Total vascular and cardiac surgery and procedures (35–39)§§	6989	4062	2927	200	655	2524	3609	1340	1550	2608	1491

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 No. 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.

‡Open heart valvuloplasty without replacement, replacement of heart valve, other operations on heart valves.

§Estimate should be used with caution as it may be unreliable.

‖Previously referred to as percutaneous transluminal coronary angioplasty or PTCA.

¶Data are for procedures with a PCI listed anywhere on the medical record. Procedures with a PCI listed were counted twice if they also had a code for insertion of stent: code 36.06: "insertion of non–drug-eluting stents," and 36.07: "insertion of drug-eluting stents."

#Ninety one percent of discharges with angioplasty were reported to have a stent inserted (personal communication with NCHS, June 15, 2007).

**Because ≥1 procedure codes are required to describe the specific bypass procedure performed, it is impossible from these (mixed) data to determine the average number of grafts per patient.

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

‡‡Includes valves, bypass and "other" open-heart procedures (codes 35 [less 35.4, 35.96], 36 [less 36.0], 37.1, 37.3–37.5). There were 126 000 other open-heart procedures in 2005.

§§Totals include procedures not shown here.

Source: National Hospital Discharge Survey, NCHS. Unpublished data, 2005. Estimates are based on a sample of inpatient records from short-stay hospitals in the United States.

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.

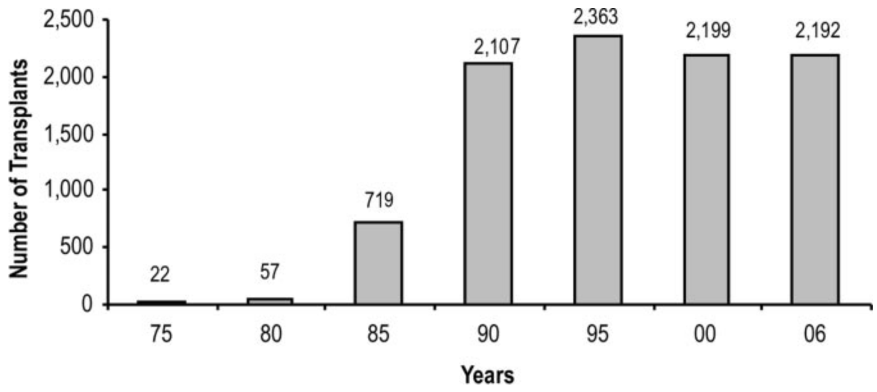

Chart 18-1. Trends in heart transplantations (United Network for Organ Sharing [UNOS]: 1975–2006). Source: UNOS, scientific registry data.

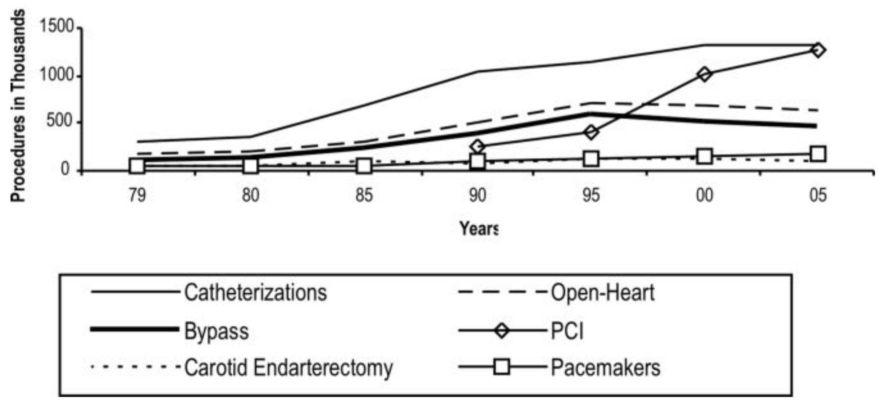

Chart 18-2. Trends in cardiovascular inpatient operations and procedures (United States: 1979–2005). Source: NHDS/NCHS, and NHLBI. Note: In-hospital procedures only.

19. Economic Cost of Cardiovascular Diseases

See Chart 19-1 and Table 19-1.[1–5]

The total direct and indirect cost of CVD and stroke in the United States for 2008 is estimated at $448.5 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). Total hospital costs (inpatients, outpatients, and emergency department patients) projected for the year 2008 are estimated to be $140.1 billion. By comparison, in 2007, the estimated cost of all cancer and benign neoplasms was $219 billion ($89 billion in direct costs, $18 billion in morbidity indirect costs, and $112 billion in mortality indirect costs). CVD costs more than any other diagnostic group.[6]

Abbreviations Used in Chapter 19

CHD	coronary heart disease
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: 2008

	Heart Diseases*	CHD	Stroke	Hypertensive Disease	HF	Total CVD†
Direct costs						
Hospital	$99.3	$51.0	$18.9	$7.6	$18.8	$140.1
Nursing home	$22.7	$11.9	$15.7	$4.6	$4.3	$46.6
Physicians/other professionals	$22.8	$12.9	$3.6	$12.8	$2.3	$44.4
Drugs/other						
Medical durables	$21.0	$9.7	$1.3	$24.1	$3.1	$49.5
Home health care	$7.0	$2.1	$4.2	$2.2	$3.2	$15.8
Total expenditures†	$172.8	$87.6	$43.7	$51.3	$31.7	$296.4
Indirect costs						
Lost productivity/morbidity	$23.1	$10.2	$6.7	$8.1	...	$37.6
Lost productivity/mortality‡	$91.4	$58.6	$15.1	$10.0	$3.1	$114.5
Grand totals†	$287.3	$156.4	$65.5	$69.4	$34.8	$448.5

Ellipses (...) indicate data not available.

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

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

‡Lost future earnings of persons who will die in 2008, discounted at 3%.

Sources: Direct costs: Extrapolation from 1995 cost estimates for CVD in Hodgson and Cohen[1] to the 2008 national health expenditure projections by the Centers for Medicare and Medicaid Services[2]; indirect morbidity costs extrapolated to 2008 from indirect cost estimates by disease in 1980 by Rice et al[3] after application of a 1980 to 2008 inflation factor computed from mean earnings published by the US Census Bureau[4]; indirect mortality costs estimated by multiplying the numbers of deaths by age, sex, and cause in 2004[5] (NCHS mortality statistics) times estimates of the present value of lifetime earnings for 2003 by age and sex (unpublished estimates) furnished by Rice, Max, Michel, and Sung (University of California, San Francisco, 2007).

All estimates prepared by Thomas Thom, NHLBI.

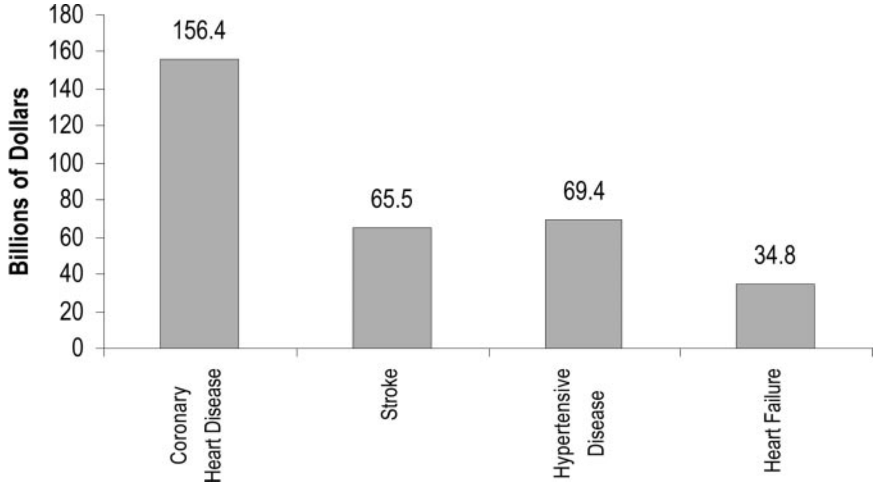

Chart 19-1. Estimated direct and indirect costs (in billions of dollars) of major cardiovascular diseases and stroke (United States, 2008). Source: NHLBI.

20. At-a-Glance Summary Tables

See Tables 20-1 through 20-4.[1–4]

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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, 2005†	80.7 M (37.1%)	37.9 M (37.5%)	37.2%	44.6%	31.6%
Mortality, 2004§	869.7 K	410.6 K	353.1 K	48.1 K	NA
CHD					
Prevalence, 2005†	16.0 M (7.3%)	8.7 M (8.9%)	9.4%	7.1%	5.6%
Prevalence, MI, 2005†	8.1 M (3.7%)	5.0 M (5.1%)	5.4%	3.9%	3.1%
Prevalence, AP, 2005†	9.1 M (4.1%)	4.4 M (4.4%)	4.8%	3.4%	2.3%
New and recurrent CHD*¶	1.2 M	710.0 K	650.0 K	65.0 K	NA
New and recurrent MI¶	920.0 K	555.0 K	NA	NA	NA
Incidence AP (stable angina)‖	500.0 K	320.0 K	NA	NA	NA
Mortality, CHD, 2004§	451.3 K	233.5 K	205.5 K	23.1 K	NA
Mortality, MI, 2004§	156.8 K	82.9 K	73.4 K	7.8 K	NA
Stroke					
Prevalence, 2005†	5.8 M (2.6%)	2.3 M (2.6%)	2.4%	4.1%	3.1%
New and recurrent strokes§	780.0 K	360.0 K	304.0 K	43.0 K	NA
Mortality, 2004§	150.1 K	58.8 K	49.3 K	7.6 K	NA
HBP					
Prevalence, 2005†	73.0 M (33.6%)	34.0 M (33.2%)	32.5%	42.6%	28.7%
Mortality, 2004§	54.7 K	23.1 K	16.7 K	5.8 K	NA
HF					
Prevalence, 2005†	5.3 M (2.5%)	2.7 M (2.8%)	2.8%	2.7%	2.1%
Mortality, 2004§**	284.4 K	122.7 K	109.9 K	10.7 K	NA
Tobacco					
Prevalence, 2005‡	46.6 M (20.9%)	25.9 M (23.9%)	24.0%	26.7%	NA
Blood cholesterol					
Prevalence, 2005					
Total cholesterol ≥200 mg/dL†	106.7 M (48.4%)	50.8 M (47.8%)	47.9%	44.8%	49.9%
Total cholesterol ≥240 mg/dL†	37.2 M (16.8%)	17.2 M (16.2%)	16.1%	14.1%	16.0%
LDL cholesterol ≥130 mg/dL†	80.4 M (32.5%)	41.3 M (32.2%)	31.7%	32.4%	39.0%
HDL cholesterol <40 mg/dL†	44.6 M (16.7%)	32.1 M (25.1%)	26.2%	15.5%	27.7%
PA#					
Prevalence, 2006‡	30.9%	33.1%	NA	NA	NA
Overweight and obesity					
Prevalence, 2005					
Overweight BMI ≥25.0 kg/m^2†	142.0 M (66.0%)	73.0 M (70.5%)	71.0%	67.0%	74.6%
Obesity BMI ≥30.0 kg/m^2†	67.3 M (31.4%)	30.7 M (29.5%)	30.2%	30.8%	29.1%
Diabetes mellitus					
Prevalence, 2005					
Physician-diagnosed diabetes†	15.1 M (7.3%)	7.6 M (7.3%)	6.7%	10.7%	11.0%
Undiagnosed diabetes†	6.0 M (2.8%)	3.7 M (3.6%)	3.2%	1.7%	1.1%
Prediabetes†	59.7 M (27.9%)	34.8 M (33.5%)	34.3%	23.1%	37.5%
Incidence, diagnosed diabetes†	1.5 M				
Mortality, 2004§	73.1 K	35.3 K	28.6 K	5.6 K	NA

AP indicates angina pectoris (chest pain); BMI, body mass index; CHD, coronary heart disease (includes heart attack, angina pectoris (chest pain), or both); CVD, cardiovascular disease; K, thousands; M, millions; MI, myocardial infarction (heart attack); mg/dL, milligrams per deciliter; and NA, not available.

*New and recurrent MI and fatal CHD.

†Age ≥20 years.

‡Age ≥18 years.

§All ages.

‖Age ≥45 years.

¶Age ≥35 years.

#Regular leisure-time physical activity.

**Total mentions.

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.[1]

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, 2005†	80.7 M (37.1%)	42.7 M (36.6%)	35.0%	49.0%	34.4%
Mortality, 2004§	869.7 K	459.1 K	396.5 K	53.9 K	NA
CHD					
Prevalence, CHD, 2005†	16.0 M (7.3%)	7.3 M (6.1%)	6.0%	7.8%	5.3%
Prevalence, MI, 2005†	8.1 M (3.7%)	3.0 M (2.5%)	2.5%	3.3%	2.1%
Prevalence, AP, 2005†	9.1 M (4.1%)	4.6 M (3.9%)	3.9%	4.3%	3.3%
New and recurrent CHD*¶	1.2 M	490.0 K	425.0 K	60.0 K	NA
New and recurrent MI¶	920.0 K	365.0 K	NA	NA	NA
Incidence AP (stable angina)‖	500.0 K	180.0 K	NA	NA	NA
Mortality, CHD, 2004§	451.3 K	217.8 K	190.2 K	23.6 K	NA
Mortality, MI, 2004§	156.8 K	73.9 K	64.2 K	8.4 K	NA
Stroke					
Prevalence, 2005†	5.8 M (2.6%)	3.4 M (2.8%)	2.7%	4.1%	1.9%
New and recurrent strokes§	780.0 K	420.0 K	343.0 K	60.0 K	NA
Mortality, 2004§	150.1 K	91.3 K	78.6 K	10.5 K	NA
HBP					
Prevalence, 2005†	73.0 M (33.6%)	39.0 M (33.6%)	31.9%	46.6%	31.4%
Mortality, 2004§	54.7 K	31.6 K	24.2 K	6.7 K	NA
HF					
Prevalence, 2005	5.3 M (2.5%)	2.7 M (2.2%)	2.1%	3.3%	1.9%
Mortality, 2004§#	284.4 K	161.6 K	145.0 K	14.3 K	NA
Tobacco					
Prevalence, 2005‡	46.6 M (20.9%)	20.7 M (18.1%)	20.0%	17.3%	NA
Blood cholesterol					
Prevalence, 2005					
Total cholesterol ≥200 mg/dL†	106.7 M (48.4%)	55.9 M (48.6%)	49.7%	42.1%	50.0%
Total cholesterol ≥240 mg/dL†	37.2 M (16.8%)	19.9 M (17.1%)	18.2%	12.5%	14.2%
LDL cholesterol ≥130 mg/dL†	80.4 M (32.5%)	39.1 M (32.4%)	33.8%	29.8%	30.7%
HDL cholesterol <40 mg/dL†	44.6 M (16.7%)	12.5 M (9.1%)	8.8%	6.9%	13.0%
PA**					
Prevalence, 2006‡	30.9%	28.9%	NA	NA	NA
Overweight and obesity					
Prevalence, 2005					
Overweight BMI ≥25.0 kg/m^2†	142.0 M (66.0%)	69.0 M (61.6%)	57.6%	79.6%	73.0%
Obesity BMI ≥30.0 kg/m^2†	67.3 M (31.4%)	36.7 M (33.2%)	30.7%	51.1%	39.4%
Diabetes mellitus					
Prevalence, 2005					
Physician-diagnosed diabetes†	15.1 M (7.3%)	7.5 M (6.8%)	5.6%	13.2%	10.9%
Undiagnosed diabetes†	6.0 M (2.8%)	2.3 M (2.0%)	1.7%	2.3%	3.1%
Prediabetes†	59.7 M (27.9%)	24.9 M (22.6%)	21.6%	20.5%	22.6%
Incidence, diagnosed diabetes†	1.5 M				
Mortality, 2004§	73.1 K	37.9 K	29.5 K	7.3 K	

AP indicates angina pectoris (chest pain); BMI, body mass index; CHD, coronary heart disease (includes heart attack, angina pectoris (chest pain), or both); CVD, cardiovascular disease; K, thousands; M, millions; MI, myocardial infarction (heart attack); mg/dL, milligrams per deciliter; and NA, not available.

*New and recurrent MI and fatal CHD.

†Age ≥20 years.

‡Age ≥18 years.

§All ages.

‖Age ≥45 years.

¶Age ≥35 years.

#Total mentions.

**Regular leisure-time physical activity.

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.[1]

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, 2005†	80.7 M (37.1%)	37.2%	35.0%	44.6%	49.0%	31.6%	34.4%	NA	NA
Mortality, 2004§	869.7 K	353.1 K	396.5 K	48.1 K	53.9 K	NA	NA	NA	NA
CHD									
Prevalence, CHD, 2005†	16.0 M (7.3%)	9.4%	6.0%	7.1%	7.8%	5.6%	5.3%	5.9%	
Prevalence, MI, 2005†	8.1 M (3.7%)	5.4%	2.5%	3.9%	3.3%	3.1%	2.1%	NA	NA
Prevalence, 2005 AP†	9.1 M (4.1%)	4.8%	3.9%	3.4%	4.3%	2.3%	3.3%	NA	NA
New and recurrent CHD*‖	1.2 M	650.0 K	425.0 K	65.0 K	60.0 K	NA	NA	NA	NA
Mortality, CHD, 2004§	451.3 K	205.5 K	190.2 K	23.1 K	23.6 K	NA	NA	NA	NA
Mortality, MI, 2004§	156.8 K	73.4 K	64.2 K	7.8 K	8.4 K	NA	NA	NA	NA
Stroke									
Prevalence, 2005†	5.8 M (2.6%)	2.4%	2.7%	4.1%	4.1%	3.1%	1.9%	2.2%‡	
New and recurrent strokes§	780.0 K	304.0 K	343.0 K	43.0 K	60.0 K	NA	NA	NA	NA
Mortality, 2004§	150.1 K	49.3 K	78.6 K	7.6 K	10.5 K	NA	NA	NA	NA
HBP									
Prevalence, 2005†	73.0 M (33.6%)	32.5%	31.9%	42.6%	46.6%	28.7%	31.4%	20.3%‡	
Mortality, 2004§	54.7 K	16.7 K	24.2 K	5.8 K	6.7 K	NA	NA	NA	NA
HF									
Prevalence, 2005†	5.3 M (2.5%)	2.8%	2.1%	2.7%	3.3%	2.1%	1.9%	NA	NA
Mortality, 2004§**	284.4 K	109.9 K	145.0 K	10.7 K	14.3 K	NA	NA	NA	NA
Tobacco									
Prevalence, 2005	46.6 M (20.9%)	24.0%	20.0%	26.7%	17.3%	NA	NA	21.1%	11.1%
Blood cholesterol									
Prevalence, 2005									
Total cholesterol ≥200 mg/dL†	106.7 M (48.4%)	47.9%	49.7%	44.8%	42.1%	49.9%	50.0%	NA	NA
Total cholesterol ≥240 mg/dL†	37.2 M (16.8%)	16.1%	18.2%	14.1%	12.5%	16.0%	14.2%	29.9%¶	
LDL cholesterol ≥130 mg/dL†	80.4 M (32.5%)	31.7%	33.8%	32.4%	29.8%	39.0%	30.7%	NA	NA
HDL cholesterol <40 mg/dL†	44.6 M (16.7%)	26.2%	8.8%	15.5%	6.9%	27.7%	13.0%	NA	NA
PA#									
Prevalence, 2006‡	30.9%	33.7%		25.3%		NA	NA	22.6%	
Overweight and obesity									
Prevalence, 2005									
Overweight BMI ≥25.0 kg/m^2†	142.0 M (66.0%)	71.0%	57.6%	67.0%	79.6%	74.6%	73.0%	39.6%‡	
Obesity BMI ≥30.0 kg/m^2†	67.3 M (31.4%)	30.2%	30.7%	30.8%	51.1%	29.1%	39.4%	27.5%‡	
Diabetes mellitus									
Prevalence, 2005									
Physician-diagnosed diabetes†	15.1 M (7.3%)	6.7%	5.6%	10.7%	13.2%	11.0%	10.9%	9.8%‡	
Undiagnosed diabetes†	6.0 M (2.8%)	3.2%	1.7%	1.7%	2.3%	1.1%	3.1%	NA	NA
Prediabetes†	59.7 M (27.9%)	34.3%	21.6%	23.1%	20.5%	37.5%	22.6%	NA	NA
Incidence, diagnosed diabetes†	1.5 M								
Mortality, 2004§	73.1 K	28.6 K	29.5 K	5.6 K	7.3 K	NA	NA	NA	NA

AP indicates angina pectoris (chest pain); BMI, body mass index; CHD, coronary heart disease (includes heart attack, angina pectoris (chest pain), or both); CVD, cardiovascular disease; K, thousands; M, millions; MI, myocardial infarction (heart attack); mg/dL, milligrams per deciliter; and NA, not available.

*New and recurrent MI and fatal CHD.

†Age ≥20 years.

‡Age ≥18 years.

§All ages.

‖Age ≥35 years.

¶BRFSS.[2]

#Regular leisure-time physical activity.

**Total mentions.

Sources: See summary tables for each chapter in this update. For data on other ethnic groups, see other chapters and Statistical Fact Sheets.[1]

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, 2004†	3.9 K	2.1 K	1.8 K	1.6 K	1.4 K	0.4 K	0.3 K	NA	NA
Mortality, 2004 (<15 years of age)	2.1 K	1.1 K	0.9 K	0.9 K	0.7 K	0.2 K	0.2 K	NA	NA
Tobacco									
Prevalence 12 to 17 years of age									
Cigarette use in past month, 2005	10.8%	10.7%	10.8%	12.5%	13.0%	7.4%	5.6%	9.2%*	9.1%*
High school students grades 9 through 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									
Mean total cholesterol mg/dL									
4 to 11 years of age	164.5	163.9	165	163.9	166.2	165.0	164.8	161.3	164.2
12 to 19 years of age	161.7	158.3	165.4	157.1	167.5	161.3	162.7	159.6	161.4
Mean HDL cholesterol mg/dL									
4 to 11 years of age	55.2	56.2	54.2	54.7	53.3	59.7	57.1	54.5	53.7
12 to 19 years of age	52.6	49.9	56.5	47.0	56.5	54.4	57.6	49.4	53.7
Mean LDL cholesterol mg/dL									
12 to 19 years of age	90.5	89.6	91.4	90.3	91.5	87.9	91.4	89.9	92.0
Mean triglycerides mg/dL									
12 to 19 years of age	94.2	96.7	91.6	102.9	46.4	71.2	69.6	98.7	99.9
PA‡									
Prevalence, 2005, grades 9 through 12‖									
Met currently recommended levels of PA	35.8%	43.8%	27.8%	46.9%	30.2%	38.2%	21.3%	39.0%	26.5%
Overweight									
Prevalence, 2005									
Preschool children 2 to 5 years of age§	14%			11.5%		13.0%		19.2%	
Children 6 to 11 years of age	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 12 to 19 years of age	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 through 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 NA, not available. Overweight in children is body mass index (BMI) 95th percentile of the CDC 2000 growth chart.

*Hispanic.

†All ages.

‡Regular leisure-time physical activity.

§2003–2004.

‖CDC. Youth Risk Behavior Surveillance, United States, 2005.[3]

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.[4]

21. Glossary

- *Age-adjusted rates*—Used mainly to compare the rates of ≥2 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. Unless otherwise noted, all death rates in this publication are age adjusted per 100 000 population and are based on underlying mortality.
- *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, to reduce its cost, to improve patient safety, to decrease medical errors, and to 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 of 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. It is 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 to . . .) (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 >90 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 regard 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. Unless otherwise stated, all death rates in this publication are age adjusted and are per 100 000 population.
- *Diseases of the circulatory system (ICD codes I00–I99)*—Included as part of what the AHA calls "cardiovascular disease." Mortality data for states can be obtained from the NCHS Web site (http://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 AHA 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,

*According to criteria established by the American Heart Association/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).

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 for whom 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 10th 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 AHA 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, <50 mg/dL [1.1 mmol/L] in women, drug treatment for reduced HDL cholesterol), elevated blood pressure (≥130 mm Hg systolic blood pressure, ≥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—ie, 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 . . .) (ongoing)
  — Honolulu Heart Program (HHP) (1965 to 1997)
  — Cardiovascular Health Study (CHS) (1988 to . . .) (ongoing)
  — Atherosclerosis Risk in Communities (ARIC) study (1985 to . . .) (ongoing)
  — 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 of 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 report reflect changes in the population size. Changes in rates can be evaluated only by comparing prevalence rates estimated from surveys conducted in different years. Estimates from NHANES 1999–2004 applied to 2005 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); cerebrovascular 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 the 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 that the decedent may also have had.

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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.