**Introduction**

Cardiovascular disease is Connecticut’s leading killer. Among both women and men, and across all racial and ethnic groups, cardiovascular disease is the state’s leading cause of mortality. More than 12,000 residents die annually of CVD, accounting for 42 percent of all deaths.

Cardiovascular disease (CVD) refers to a variety of diseases and conditions affecting the heart and blood vessels. The major cardiovascular diseases are coronary heart disease (CHD), cerebrovascular disease, and congestive heart failure (CHF) (Fig. 1).

**FIGURE 1**

Cardiovascular Disease Deaths Connecticut, 1996-1998

- **Coronary Heart Disease**: 57%
- **Cerebrovascular Disease**: 15%
- **Hypertension with or w/o Renal Disease**: 1%
- **Congestive Heart Failure**: 5%
- **Other**: 21%
- **Atherosclerosis**: 1%

Coronary heart disease refers to any condition that reduces the flow of blood to the heart muscle. The blockage of blood flow can lead to chest pain (angina), irregular heart beats, or death of the heart muscle (heart attack). Cerebrovascular disease, more commonly referred to as stroke, occurs when the blood supply to a part of the brain is interrupted. Congestive heart failure is a heart disease condition that involves loss of pumping ability by the heart, generally accompanied by fluid accumulation in organs like the lungs. It occurs when the heart becomes progressively weaker due to conditions such as high blood pressure or heart attack.

Chronic diseases like CVD are among the most prevalent, costly, and preventable of all health problems. CVD is the leading cause of death and hospitalization for Connecticut men and women in all age groups above 45 years. CVD is also the most expensive medical condition, accounting for one-seventh of health spending. The challenge is to control the social, economic, and medical burden arising from CVD, which, in turn, is driven by demographic, risk factor, and medical care trends.

**Health Burden**

The number of deaths in Connecticut from all causes is approximately 30,000 per year, of which 12,000 (42%) are due to CVD. In comparison, cancer, the second leading cause of death, accounts for 24 percent of all deaths. Seventy-eight percent of all deaths occur in people aged 65 and over, whereas 87 percent of CVD deaths occur in this age group. CVD not only affects the elderly; it is also the second leading cause of premature death under age 75. Although CVD is assumed to be a disease primarily of men, over half (55%) of all Connecticut deaths caused by CVD are among women. According to the most recent National Center’s for Health Statistics calculations, the probability at birth of eventually dying from cardiovascular disease is more than twice that of dying from cancer (47% vs. 22%).

A consideration of deaths alone underestimates the burden of CVD. CVD is also the leading cause of hospitalization for the state’s residents (excluding childbirth) and a leading cause of disability among working adults. Approximately 61,500 resident hospitalizations annually are due to CVD, or approximately 23 percent of all hospitalizations, excluding newborns and pregnancy-related conditions.

**Mortality**

When considered separately among cardiovascular diseases, coronary heart disease ranks slightly below cancer as the leading cause of death in Connecticut (7,000 annual deaths), and cerebrovascular disease ranks as the third leading cause of death (2,000 annual deaths).

Age and sex differences in CVD mortality are well established. Mortality rates increase with age and males experience greater overall death rates and age-specific death rates than females (Table 1). These relationships also hold for coronary heart disease-specific death rates.

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*For purposes of discussion, cerebrovascular disease and stroke will be used interchangeably. Technically stroke is a subcategory, but it accounts for 86 percent of cerebrovascular disease deaths in Connecticut.*
The risk of death due to CHD in females is roughly that of males ten years younger. It has been assumed that normal estrogen levels in pre-menopausal women provide a protective benefit against heart disease and possibly stroke, but recent research questions that reasoning. Sex-specific death rates due to cerebrovascular disease are not as disparate and are highest for females 85 years and older.

**TABLE 1. MORTALITY RATES**  

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Cardiovascular Disease Mortality Rates</th>
<th>Coronary Heart Disease Mortality Rates</th>
<th>Cerebrovascular Disease Mortality Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>&lt; 45</td>
<td>16.3</td>
<td>8.3</td>
<td>7.9</td>
</tr>
<tr>
<td>45-54</td>
<td>149.7</td>
<td>60.9</td>
<td>103.0</td>
</tr>
<tr>
<td>55-64</td>
<td>455.4</td>
<td>201.2</td>
<td>297.3</td>
</tr>
<tr>
<td>65-74</td>
<td>1,130.6</td>
<td>622.5</td>
<td>711.4</td>
</tr>
<tr>
<td>75-84</td>
<td>2,995.7</td>
<td>2,058.2</td>
<td>1,768.9</td>
</tr>
<tr>
<td>85+</td>
<td>8,083.0</td>
<td>7,940.7</td>
<td>4,564.0</td>
</tr>
<tr>
<td>AAMR*</td>
<td>406.6</td>
<td>285.7</td>
<td>243.0</td>
</tr>
<tr>
<td>Total Deaths</td>
<td>16,747</td>
<td>20,586</td>
<td>10,077</td>
</tr>
</tbody>
</table>

* AAMR refers to age-adjusted mortality rate.

Cardiovascular disease death rates, particularly coronary heart disease rates, have been steadily declining over the past decade. Significant declines have occurred overall in both sexes, but primarily in those whose race is white (Fig. 2). The sex differences in mortality and time trends are likely due to differing lifestyle factors, such as smoking and diet. Improved medical and surgical care has also contributed to the changes.

Although CHD mortality rates have decreased significantly for those whose race is white, rates among blacks and Hispanics have not statistically significantly changed since 1989; rather they have fluctuated with a large degree of variability. Because they have not changed over time, black female mortality rates are significantly greater than white female rates, which have declined (Fig. 2). Black women are more likely to have certain CHD risk factors, such as being overweight or having hypertension or diabetes, and are less likely to receive particular treatments like bypass surgery.

Low Hispanic mortality has been consistently seen in national studies and is still largely unexplained. However, Hispanics tend to have fewer classic CHD risk factors when compared to white populations. In Connecticut, significantly smaller percentages of Hispanics have reported having been told they have high blood pressure or high cholesterol levels than have white, non-Hispanics.

Although stroke mortality rates have not significantly changed during the last decade in Connecticut, relative differences exist similar to CHD mortality rates between sexes and among race and ethnic groups (data not shown). Unlike stroke, age-adjusted death rates for congestive heart failure have increased significantly from 1989 to 1998 (data not shown). Increasingly people are surviving heart attacks and preventing strokes, thereby increasing their risk for CHF.

**Morbidity**

During 1999 there were approximately 61,500 discharges from Connecticut hospitals with some type of CVD as the first-listed diagnosis. They accounted for 23 percent of all discharges, excluding newborns and conditions relating to pregnancy and childbirth, making CVD the leading cause of hospitalization. Of these discharges, 23,300 (38%) were for patients with CHD, 9,400 (15%) were for patients with cerebrovascular disease, and 9,600 (16%) discharges had congestive heart failure (Table 2).
Sixty-two percent of CHD discharges were for people aged 65 years and over, whereas 78 percent of strokes and 82 percent of CHF discharges were in this age group. One third of CHD discharges occurred in patients aged 45-64, indicating that heart disease is not just a disease of the elderly. The median lengths of stay for patients with CHD, stroke, and CHF in 1999 were 3 days, 4 days, and 4 days, respectively, each of which was two days shorter than comparable hospital stays in 1993. These declines are most likely due to medical advances and managed care’s efforts to control costs.

From 1993 to 1999, CHD hospitalization rates for males and females have decreased, particularly since 1996, but rates have remained relatively stable for cerebrovascular disease and congestive heart failure hospitalizations (Fig. 3). Although male hospitalization rates are significantly greater than female rates, actual numbers of hospitalizations are higher for females with cerebrovascular disease and congestive heart failure (Table 2).

Compared to other race and ethnic groups, black, non-Hispanics have significantly higher hospitalization rates for cerebrovascular disease and congestive heart failure, whereas white non-Hispanics have higher rates for CHD (Fig. 4). The latter is true for males only (data not shown). Hispanics tend to have lower CVD hospitalization rates. This correlates with their lower mortality rates.

**Risk Factors**

Besides the many people who already have one or more types of CVD, many more are at risk for developing the disease. Inherent and modifiable factors have been identified that are associated with an increased risk of developing CVD. CVD-associated risk factors that cannot be changed include positive family history, increasing age, male gender, and black race. Although these factors cannot be modified, their presence helps identify those at greatest risk. Major risk factors that can be modified, either by lifestyle changes or through medication, include cigarette smoking, high blood cholesterol levels, high blood pressure, diabetes, physical inactivity, and being overweight or obese. CVD risk factors tend to cluster, and the more risk factors that a person has, the greater the likelihood of developing CVD.

### TABLE 2. CARDIOVASCULAR DISEASE HOSPITALIZATIONS Connecticut, 1999

<table>
<thead>
<tr>
<th></th>
<th>Coronary Heart Disease Hospitalizations</th>
<th>Cerebrovascular Disease Hospitalizations</th>
<th>Congestive Heart Failure Hospitalizations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>AAHR*</td>
<td>Number</td>
</tr>
<tr>
<td>Males</td>
<td>14,238</td>
<td>928.4</td>
<td>4,351</td>
</tr>
<tr>
<td>Females</td>
<td>9,049</td>
<td>435.5</td>
<td>5,031</td>
</tr>
<tr>
<td>All</td>
<td>23,287</td>
<td>657.9</td>
<td>9,382</td>
</tr>
</tbody>
</table>

* AAHR refers to age-adjusted hospitalization rates.

![Figure 3](image3.png)

**FIGURE 3. Selected Cardiovascular Diseases Age-Adjusted Hospitalization Rates Connecticut, 1993-1999**

- Male CHD
- Female CHD
- Male Cerebrovascular
- Female Cerebrovascular
- Male CHF
- Female CHF

![Figure 4](image4.png)

**FIGURE 4. Selected Cardiovascular Diseases Age-Adjusted Hospitalization Rates Connecticut, 1997-1999**

- White nH
- Black nH
- Hispanic

Note: nH refers to non-Hispanic.
A positive family history of CVD is often considered a risk correlate.\textsuperscript{11} Its independent effect is difficult to ascertain because familial influences on CVD risk status tend to be mediated in part through blood pressure and blood cholesterol and indirectly through diet.

Similarly race and ethnicity are risk markers, rather than risk factors. Race and ethnicity are constructs used by health researchers to reflect socially distinct groups who share certain cultural, linguistic, socioeconomic, and/or other characteristics. They are used to identify high-risk populations who may also be affected by racism, segregation, and discrimination.\textsuperscript{12}

Obesity and physical inactivity exert much of their adverse influence on the development of CVD through the other major risk factors. Nevertheless, they are important modifiable, contributory factors. The remaining modifiable risk factors have been shown to have independent effects on CVD.

Smoking increases the incidence of all major forms of heart disease and stroke. In 1998-1999 more than 1 in 5 Connecticut adults indicated that they smoked cigarettes (Table 3). The rates are highest (35\%) in the youngest adult age group (18-24 years old), decreasing to 11 percent in the 65-and-older age group.\textsuperscript{13} The unfavorable smoking patterns among the younger age groups may contribute substantially to the future burden of CVD.

Elevated low density lipoproteins (LDL) and low levels of high density lipoproteins (HDL) are risk factors for the development of CVD. Total cholesterol level is a less informative measure because it includes both LDL and HDL, which have opposite effects. Nevertheless, a high total cholesterol level is a major risk factor. During 1998-1999, 80 percent of Behavioral Risk Factor Surveillance System respondents in Connecticut reported ever having their cholesterol levels tested. Of those tested, 27 percent indicated that they had been told that their cholesterol was high (Table 3).

High blood pressure is also a major risk factor for heart disease and stroke. It is associated with a 50 percent increase in CHD risk over those without the condition. It is also the most important treatable risk factor for stroke. Most estimates for hypertension indicate a relative risk of stroke of approximately 3-4.\textsuperscript{15} In 1998-1999, 22 percent of Connecticut adults reported that they had high blood pressure diagnosed by a health professional (Table 3). Development of high blood pressure is more likely to occur in people who are overweight and physically inactive, use alcohol heavily, or have excessive salt intake. The prevalence of being overweight or obese has increased significantly in Connecticut in the past decade. Diets high in saturated fat combined with sedentary lifestyles lead to excess weight. Nearly 63 percent of Connecticut males are considered overweight versus 40 percent of females. More than 70 percent of blacks are deemed to be overweight.\textsuperscript{16} Being overweight affects the development of high blood pressure and diabetes, which, in turn, are important risk factors for heart disease and stroke.

Physical activity is beneficial in reducing CVD risk by helping to reduce body weight and by improving cholesterol levels, blood pressure, and blood sugar levels. Yet, nearly 80 percent of Connecticut adults have no regular physical activity (Table 3).

Diabetes is a significant risk factor for the development of high blood pressure, stroke, and heart disease, particularly in women. Of the modifiable risk factors, diabetes has the highest relative risk (Table 3). Diabetes not only increases the incidence of CVD but adversely influences outcomes as well - individuals with diabetes have a higher mortality rate from heart disease.

The high prevalence of major risk factors continues to contribute to the high rates of heart disease and stroke in Connecticut. Among Connecticut adults aged 18 and older, 93 percent reported having at least one of the six modifiable CVD risk factors and 28 percent reported having at least three.\textsuperscript{17} This does not bode well for the future when the latent effects of the risk factors will manifest themselves in the form of CVD or other preventable disorders.

### TABLE 3. CVD RISK FACTORS

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Percent Reporting Presence of Risk Factor(^*)</th>
<th>CHD Relative Risk for Males(^\text{\text{14}}) (95% CI)</th>
<th>CHD Relative Risk for Females(^\text{\text{14}}) (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cigarette/tobacco smoking</td>
<td>22%</td>
<td>1.6 (1.4, 1.8)</td>
<td>1.8 (1.5, 2.1)</td>
</tr>
<tr>
<td>High blood cholesterol</td>
<td>27%</td>
<td>1.4 (1.2, 1.6)</td>
<td>1.1 (0.9, 1.2)</td>
</tr>
<tr>
<td>High blood pressure</td>
<td>22%</td>
<td>1.5 (1.3, 1.7)</td>
<td>1.5 (1.3, 1.8)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>4%</td>
<td>1.9 (1.5, 2.5)</td>
<td>2.4 (1.9, 3.0)</td>
</tr>
<tr>
<td>Being overweight or obese</td>
<td>51%</td>
<td>1.3 (1.1, 1.5)</td>
<td>1.4 (1.2, 1.6)</td>
</tr>
<tr>
<td>Physical inactivity</td>
<td>80%</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

\(^\text{14}\) Source: Bittner, 1994.  
CI = Confidence interval.  
N/A = Not available.
Prevention

Preventive measures for heart disease and stroke include screening for existing risk factors, lifestyle modifications, or pharmacologic interventions. Early intervention will lessen the severity of risk factors that are the result of the non-modifiable factors of aging and genetics. Recommended modifications include smoking cessation, weight management, increasing physical activity, incorporating a diet low in salt and saturated fat and rich in fruits and vegetables, and treating high blood pressure and high cholesterol levels.

For women with no known CHD, the preventive role of hormone replacement therapy (HRT) is not well established. In secondary prevention, HRT has not been shown to reduce death or morbidity among women with established CHD, and therefore is not recommended for this purpose. Although several clinical trials have shown cholesterol-reduction therapy to be effective for primary prevention of CHD in patients at high absolute risk, the use of such therapy in patients at low-to-moderate risk is still under investigation. However, cholesterol-lowering agents, such as statins, have proven to be efficacious in secondary prevention of CHD, which, in turn, may also result in stroke prevention. Other accepted secondary preventive measures for CHD include the use of aspirin, beta blockers, angiotensin-converting enzyme (ACE) inhibitors, and revascularization procedures.

CHD Treatment: Revascularization Procedures

Revascularization procedures are surgical procedures, such as coronary artery bypass grafting (CABG) and percutaneous transluminal coronary angioplasty (PTCA), that provide for a new, additional, or augmented blood supply to the heart. They are effective, but invasive and costly, treatments for coronary heart disease. In Connecticut, the number of PTCAs continues to grow while the number of bypass procedures has started to decline (Fig. 5). Cost is one likely explanation for this divergence. Average hospitalization charges for CABG procedures are approximately $44,000 compared to $21,000 for PTCAs; and patients’ hospital stays are on average 10 days versus 3 days, respectively. Another explanation for the increase is that patients, who initially received angioplasties, are being readmitted for repeat procedures due to restenosis of their arteries. Implantation of a drug-coated stent into the blocked artery may help to alleviate this problem.

FIGURE 5
No. of Discharges Receiving Revascularization Procedures
Connecticut, 1993-1999

Studies have used hospitalizations for acute myocardial infarctions (AMI) as a proxy for the incidence of heart disease because those with the condition will seek care, and there is consensus regarding the necessity for admission. For patients presenting with acute myocardial infarctions in Connecticut, women received fewer revascularization procedures than men. During the period 1997-1999, 20 percent of female AMI discharges received PTCA and 9 percent had CABG surgery whereas 28 percent of male AMI discharges had PTCA and 12 percent CABG. Women were older than men (73 vs. 66 years of age on average, respectively) and tended to have more comorbidities. Even after controlling for age, women received fewer procedures. It is unknown whether women with AMI are being less aggressively treated or whether they have fewer clinical manifestations warranting revascularization.

Economic Burden

Not only is CVD a considerable health burden, it is also a significant economic burden, which will continue to grow as the population ages. In the United States, the estimated annual cost of CVD is nearly $300 billion or $1,100 per person. This figure includes direct costs of health expenditures (60%) and indirect costs of lost productivity resulting from illness and death (40%). Assuming that disease rates and per person expenditures in Connecticut are the same as those nationwide, the estimated annual cost of CVD in Connecticut is $3.6 billion. The estimated annual costs of CHD, stroke, and CHF in Connecticut are $1.2 billion, $500 million, and $500 million, respectively. The use of expensive treatment, while often effective in delaying death from CVD, is likely to continue to increase the financial impact of this disease.

The majority of the cost for CVD is for inpatient hospitalizations. Total charges associated with 1999 CVD hospitalizations in Connecticut were close to $1.1 billion. The median charge was approximately $11,000. Sixty-six percent of the hospitalizations had Medicare as their expected payer. This percentage has remained relatively constant from 1993 through 1999. In 1993 only 7 percent of the CVD hospitalizations were covered by managed care organizations. By 1999 the percentage had more than doubled to 16 percent.
Conclusion

The considerable health and economic burdens of cardiovascular disease demonstrate the need to reduce its incidence, improve the treatment of its manifestations, and reduce its long-term disability and mortality. Although great advances have been made in treating CVD, changing one’s habits remains the most effective way to stop the progression of the disease. Benefits arise from a low-fat diet rich in fruits and vegetables, increasing physical activity, and not smoking. Individual efforts, however, need to be promoted and supported by health programs and policies. For instance, heart healthy foods should be more readily available in school and workplace cafeterias; smoking prevention and cessation programs need to be supported by policies that address the social, economic, and commercial aspects of tobacco use; and more places need to be provided where children and adults can safely engage in physical activity. These endeavors will help individuals to lower cholesterol and blood pressure and to lose weight. Screening for risk of CVD, altering lifestyles, and receiving appropriate medical interventions provide opportunities to prevent CVD and to reduce related health expenditures.

References


13 Adams M. op. cit.


16 Adams M. op. cit.

17 Adams M. op. cit.

