The Burden of Cardiovascular Diseases in Connecticut

2010 Surveillance Report

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EXECUTIVE SUMMARY

- Cardiovascular diseases (CVD) are a great public health concern. CVD account for about one-third of all Connecticut resident deaths. Coronary heart disease (CHD), cerebrovascular disease (stroke) and heart failure (HF) are the main types, accounting for 48%, 15%, and 8% respectively of all CVD deaths.

- The CVD, CHD, and stroke age-adjusted mortality rates of Connecticut residents decreased significantly between 1999 and 2008.

- Approximately 55% of all Connecticut resident CVD deaths are among females. However, males have significantly higher age-adjusted CVD mortality rates (2006-2008 data).

- Black Connecticut residents have the highest age-adjusted CVD mortality rate as well as higher age-adjusted CVD, CHD, and stroke premature mortality rates compared with White and Hispanic residents (2006-2008 data).

- Hispanic Connecticut residents have significantly lower age-adjusted CVD and CHD mortality rates than White residents (2006-2008 data).

- About 18% of all hospital discharges in Connecticut are due to CVD. Approximately 26% of CVD hospitalizations are due to CHD, 12% to stroke, and 18% to HF (2008 data).

- Connecticut male residents have higher age-adjusted rates of hospitalizations for CVD, CHD, stroke, and HF than female residents. Black Connecticut residents have higher rates of hospitalizations for CVD, stroke, and HF than White and Hispanic residents (2008 data).

- About $2.2 billion was billed for CVD hospitalizations in Connecticut in 2008. Approximately 34% of CVD charges are for CHD, 12% for stroke, and 12% for HF. CVD also incur enormous indirect costs.

- Risk factors for CVD may be modifiable or non-modifiable. Key modifiable risk factors are high blood pressure, high blood cholesterol, smoking, diabetes, obesity, and physical inactivity. Non-modifiable risk factors include increasing age and family history of heart disease and stroke.

- High blood pressure (HBP) is a major risk factor for heart attack and stroke. About 27% of Connecticut adults have HBP. Connecticut males are more likely than females to have HBP. About 25% of White, 36% of Black, and 22% of Hispanic adults in Connecticut have HBP. Also, Connecticut adults with lower annual household incomes are more likely to have HBP compared to adults with higher annual household incomes (2007-2009 data).

- High blood cholesterol (HBC) is a major risk factor for CHD. About 38% of Connecticut adults have HBC. Connecticut males are more likely than females to have HBC. The prevalence of HBC increases with age. Black and Hispanic Connecticut adults are less likely than White adults to have had their blood cholesterol tested. Connecticut adults with lower annual household incomes are less likely than adults with higher annual household incomes to have had their blood cholesterol tested (2007-2009 data).

- Cigarette smoking increases the risk of heart attack, stroke, and death from CHD. About 16% of Connecticut adults are current smokers. Current adult smokers are more likely to be younger, have lower annual household incomes, and be less educated. Among adults, smoking rates do not vary significantly by gender or race and ethnicity (2007-2009 data). According the 2009 Connecticut School Health Survey, 15.3% of high school students are current smokers. White high school students are more likely than Black and Hispanic students to be current smokers.

- Diabetes has been recognized as a major risk factor for CVD. An estimated 6.9% of Connecticut adults have diagnosed diabetes. Connecticut males are more likely to have diabetes than females. Also, high rates of diabetes are associated with older age, lower socioeconomic position, and racial and ethnic minority status. About 5.6% of White, 14.9% of Black, and 10.5% of Hispanic adults in Connecticut have diabetes (2007-2009 data).

- Obesity is an independent risk factor for CVD. An estimated 10.4% of high school students in Connecticut are obese. High school males are more likely to be obese than females and Hispanic students are more likely to be obese than White and Black students (2009 data). Approximately 21% of Connecticut adults are obese. Older adults are more likely to be obese than younger adults; males are more likely to be obese than females; and those with lower annual household incomes are more likely to be obese than those with higher annual household incomes. Also, Black and Hispanic adults are more likely to be obese than White adults (2007-2009 data).

- Physical inactivity is associated with an increased risk of a number of chronic health conditions including CHD, high blood pressure, and obesity. Approximately 47% of Connecticut adults participate in less than the recommended amount of physical activity. Older adults, females, and adults with lower annual household incomes have higher rates of physical inactivity. About 44.5% of White, 59.7% of Black, and 54.2% of Hispanic Connecticut adults are physically inactive (2007-2009 data).

- The co-prevalence of risk factors places an individual at elevated risk for CHD and stroke. About 42% of Connecticut adults have two or more modifiable risk factors for CVD (2007-2009 data).

- Early recognition of the signs and symptoms of heart attack and stroke increase the likelihood of immediate emergency transport to the hospital and timely medical care. Only 13.6% of Connecticut adults can identify all the proper heart attack signs and only 22.6% can identify all the proper stroke signs. Women tend to be more knowledgeable than men about the signs and symptoms of heart attack and stroke (2007-2009 data).

- Access to health care is crucial to the prevention, treatment, and management of CVD. About 9% of adults in Connecticut do not have health insurance. Approximately 6% of White, 21% of Black, and 30% of Hispanic adults in Connecticut do not have health insurance (2007-2009).

- Targeted public health interventions are warranted for all Connecticut residents with multiple risk factors. Special emphasis should be placed on evidence-based interventions that address risk factor reduction among Black, Hispanic, and lower-income Connecticut adults.

THE BURDEN OF CARDIOVASCULAR DISEASES IN CONNECTICUT

INTRODUCTION

Cardiovascular disease refers to a wide variety of heart and blood vessel diseases. The most common forms of cardiovascular disease are coronary heart disease (CHD) and cerebrovascular disease. Essential hypertension, heart failure (HF), and atherosclerosis are other common cardiovascular diseases (CVD).[1] CVD are of great public health concern because more than one-third of all deaths in Connecticut are due to CVD and because prevention efforts have shown great potential in reducing the morbidity, mortality, and disability of CVD.[2, 3]

MORTALITY

CVD accounted for 9,351 Connecticut resident deaths in 2008, or about 33% of all deaths for the period. In contrast, cancer deaths accounted for 24%; chronic lower respiratory disease, 5%; unintentional injuries, 5%; and diabetes, 2% of all Connecticut resident deaths (Table 1).[3]

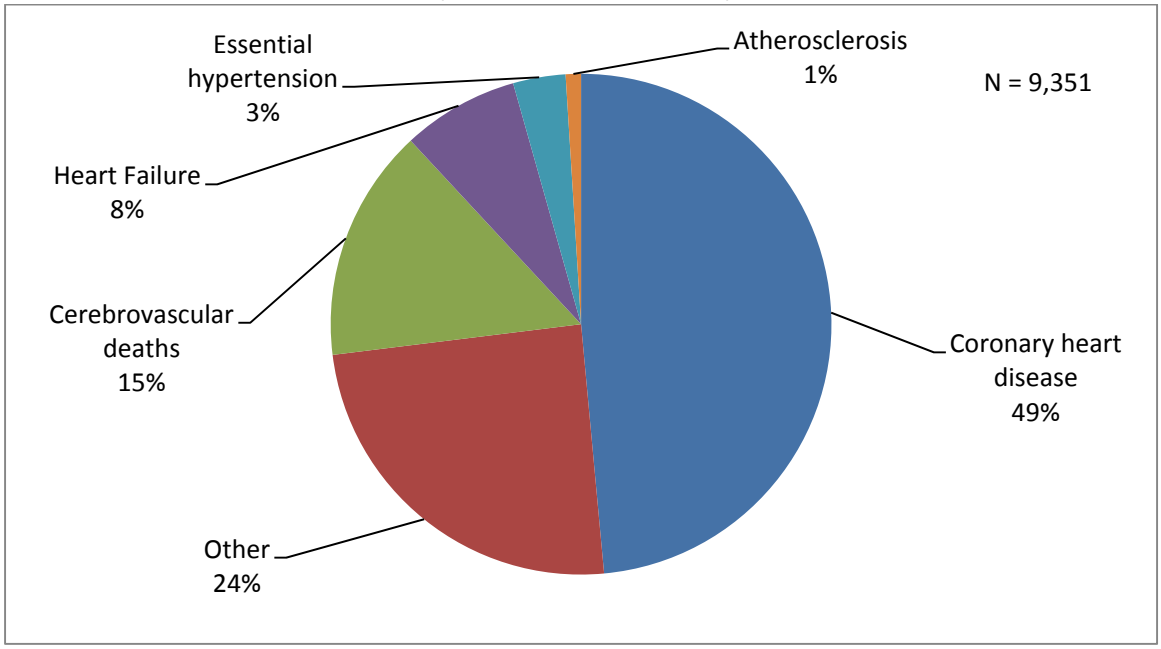
Table 1. Connecticut Resident Deaths, 2008

Cause of Death	Number of Deaths	Percent of Deaths
All Causes	28,749	100%
Cardiovascular Disease	9,351	33%
Cancer	6,765	24%
Chronic Lower Respiratory Disease	1,494	5%
Unintentional Injury	1,362	5%
Alzheimer's Disease	831	3%
Pneumonia and Influenza	688	2%
Diabetes	618	2%

Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

The major CVD are CHD and cerebrovascular disease or "stroke". Stroke is the most severe clinical manifestation of cerebrovascular disease, and the terms are used interchangeably in this report.[4] CHD accounts for 49% of all CVD deaths and includes hypertensive heart disease and ischemic heart disease (2008 data). Stroke is responsible for about 15% of CVD deaths in Connecticut, and includes two major types - ischemic stroke and hemorrhagic stroke. HF accounts for 8% of all CVD deaths, while essential hypertension and atherosclerosis account for 4% of all CVD deaths in Connecticut (Figure 1).[3]

Figure 1. Cardiovascular Disease Deaths, Connecticut Residents, 2008

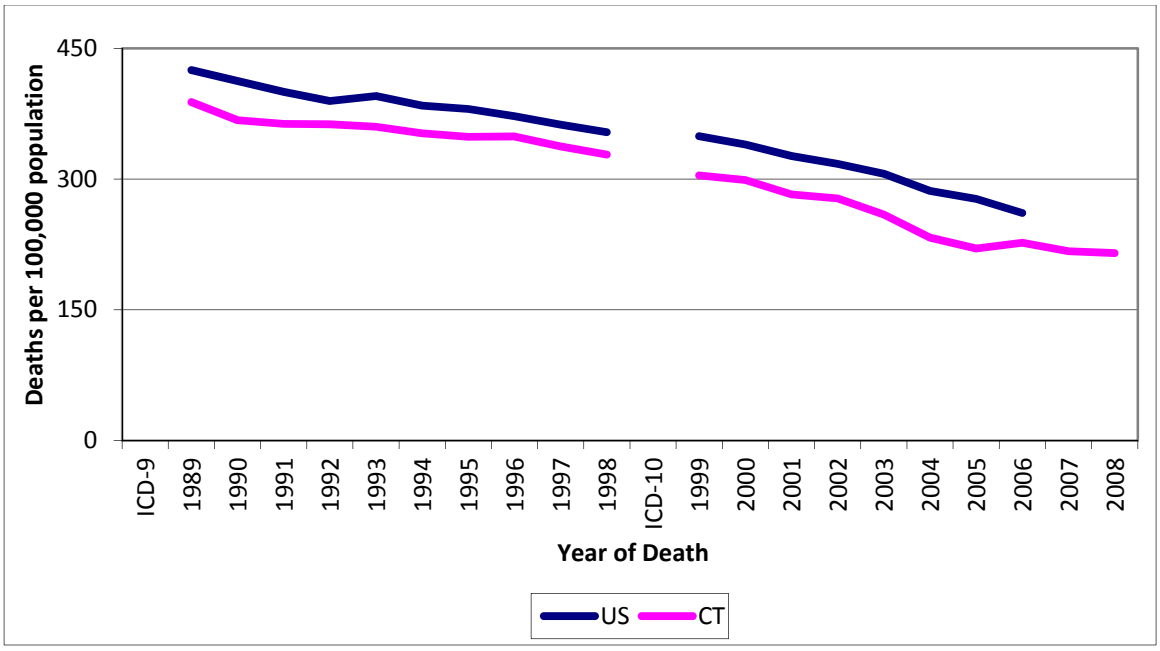


Sources: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

Trends in Age-adjusted Mortality

Since the 1990s, CVD and CHD mortality rates* have decreased significantly for all Connecticut residents.[5, 6] This continuing decrease in Connecticut CVD and CHD mortality rates mirrors a similar decline in CVD and CHD mortality rates nationwide.[7] CVD and CHD mortality rates for Connecticut residents have been consistently lower than those for the United States population (Figure 2 and Figure 3).[3, 7] Since 2001, the Connecticut resident CHD mortality rate has been below the *Healthy People 2010* target of 166 per 100,000 population (Figure 3). There is no *Healthy People 2010* target for CVD.[8]

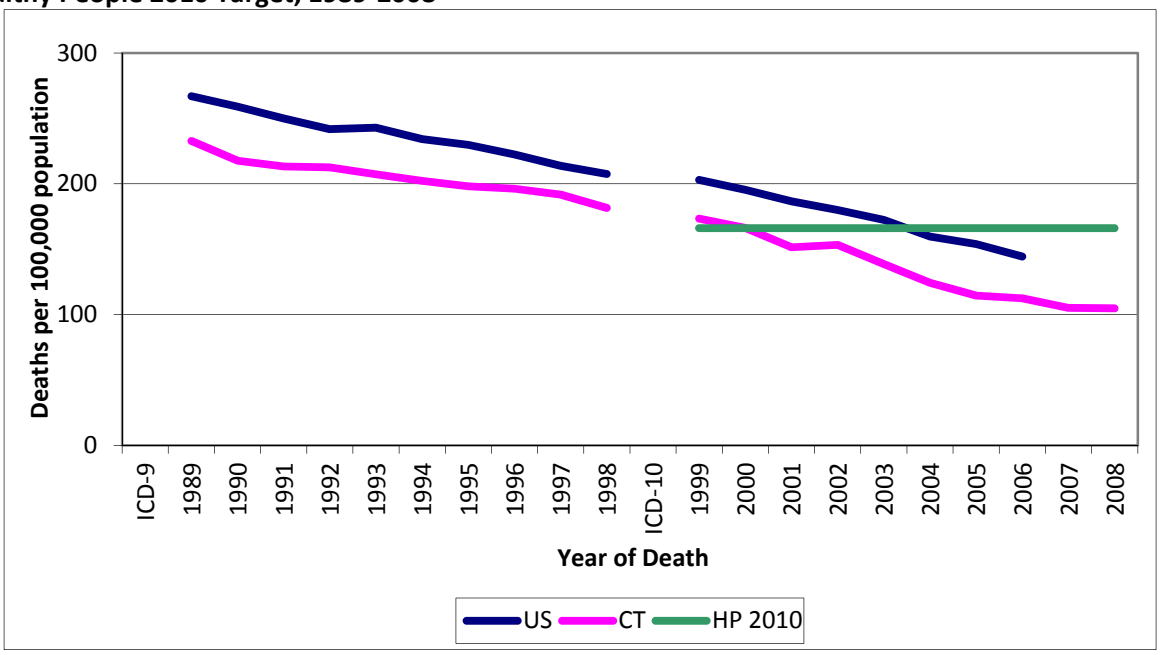
Figure 2. Age-adjusted Mortality Rates for Cardiovascular Disease, Connecticut & United States, 1989-2008



Sources: Connecticut Department of Public Health, Vital Statistics Mortality Files, 2010. Centers for Disease Control and Prevention, 2010. Note: Rates are adjusted to the 2000 US standard population. Classification includes deaths with ICD-9 codes: 390-459.9 (1989 to 1998); ICD-10 codes: I00-I78.9 (1999 to 2008).

* The mortality rates presented in this report are age-adjusted mortality rates (AAMR). The AAMRs were computed by the direct method using the 2000 U.S. standard million population. The AAMRs were calculated using the death records of Connecticut residents.

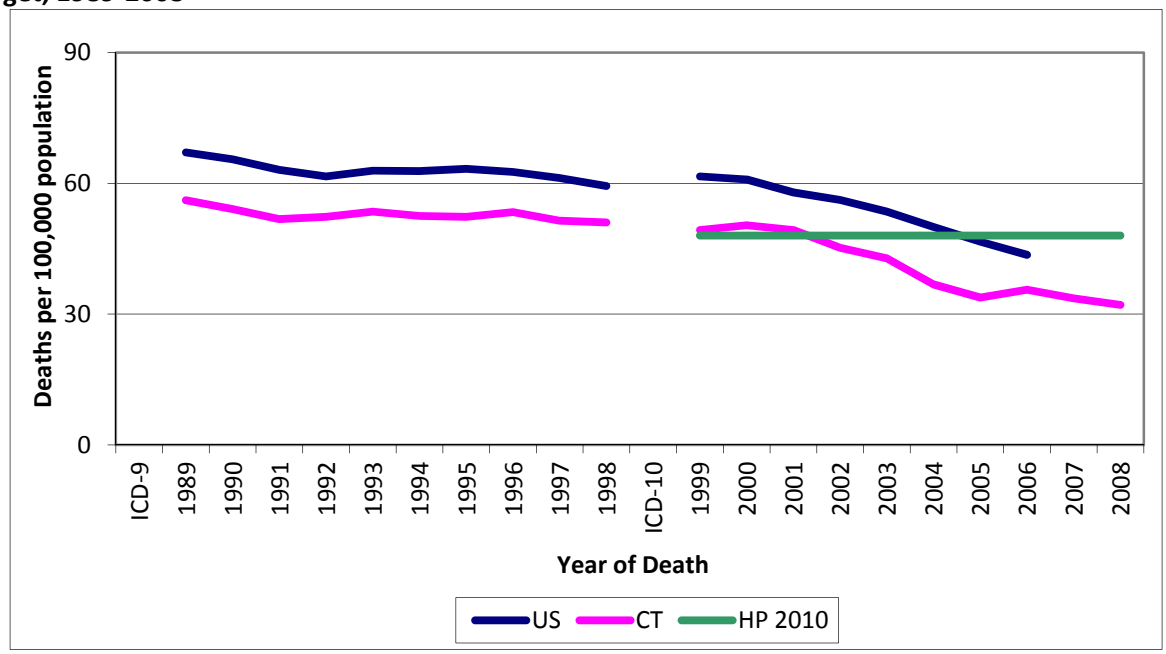
Figure 3. Age-adjusted Mortality rates for Coronary Heart Disease, Connecticut, United States, & Healthy People 2010 Target, 1989-2008



Source: Connecticut Department of Public Health, Vital Statistics Mortality Files, 2010. Centers for Disease Control and Prevention, 2010. Note: Rates are adjusted to the 2000 US standard population. Classification includes deaths with ICD-9 codes: 402,410-414, 429.2 (1989 to 1998); ICD-10 codes: I11, I20-25 (1999 to 2008).

Stroke mortality rates of Connecticut residents did not change significantly in the 1990s.[5] However, decreasing trends have been observed since 1999.[6] Connecticut resident mortality rates from stroke have been consistently lower than those of the U.S.[7] Since 2002, the Connecticut resident stroke mortality rate has been below the *Healthy People 2010* target of 48 per 100,000 population (Figure 4).[3, 8]

Figure 4. Age-adjusted Mortality Rates for Stroke, Connecticut, United States, & Healthy People 2010 Target, 1989-2008

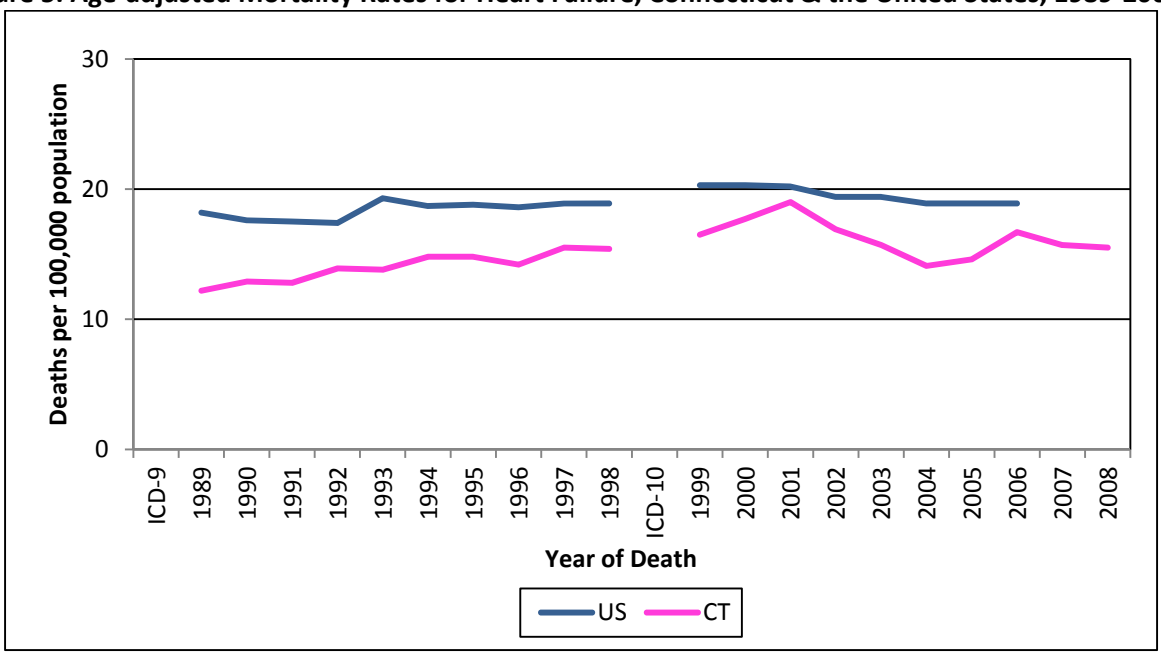


Sources: Connecticut Department of Public Health, Vital Statistics Mortality Files, 2010. Centers for Disease Control and Prevention, 2010. Note: Rates are adjusted to the 2000 US standard population. Classification includes deaths with ICD-9 codes: 430-438 (1989 to 1998); ICD-10 codes: I60-69 (1999 to 2008).

During the 1990s, the Connecticut resident HF mortality rates increased significantly.[5] The increase in the HF mortality rates throughout the 1990s has been attributed to more people surviving heart attacks experienced earlier in life and to the aging population.[1] Approximately 60% of all HF deaths in Connecticut occur in persons aged 85 or older. In contrast, 45% of all CHD deaths and 49% of all cerebrovascular disease deaths occur in persons 85 and older.[7] The 2006-2008 Connecticut resident HF mortality rate was significantly lower than the 1999-2001 rate [data not shown]; however, linear trend analyses of HF mortality rates did not show a statistically significant change ($p \leq 0.05$) for the period 1999-2008.[3, 6]

Connecticut HF mortality rates have been consistently lower than those of the U.S.[3, 7] There is no *Healthy People 2010* target for HF (Figure 5).[8]

Figure 5. Age-adjusted Mortality Rates for Heart Failure, Connecticut & the United States, 1989-2008



Sources: Connecticut Department of Public Health, Vital Statistics Mortality Files, 2010. Centers for Disease Control and Prevention, 2010. Note: Rates are adjusted to the 2000 US standard population. Classification includes deaths with ICD-9 code: 428.0 (1989 to 1998); ICD-10 code: 150.0 (1999 to 2008).

Mortality by Gender

Approximately 55% of all Connecticut resident CVD deaths are among females (2006-2008 data). While more females than males die from CVD in Connecticut, males have higher CVD mortality rates (Table 2). Connecticut males have a 45% higher mortality rate due to CVD compared with females, a 71% higher mortality rate due to CHD, and a 30% higher mortality rate due to HF ($p<0.001$ for all comparisons). The stroke mortality rates of Connecticut males and females do not differ significantly.[3]

Table 2. Cardiovascular Diseases Deaths and Age-adjusted Mortality Rates (AAMR) per 100,000 Population, Connecticut Residents, 2006-2008

Cause of Death	All		Male		Female	
	Deaths	AAMR	Deaths	AAMR	Deaths	AAMR
All Cardiovascular Diseases	28,369	219.7	12,889	266.8	15,480	184.4
Coronary Heart Disease	13,840	107.4	6,874	141.3	6,966	82.7
Stroke	4,385	33.8	1,646	34.5	2,739	32.6
Heart failure	2,139	16.0	863	18.6	1,276	14.4

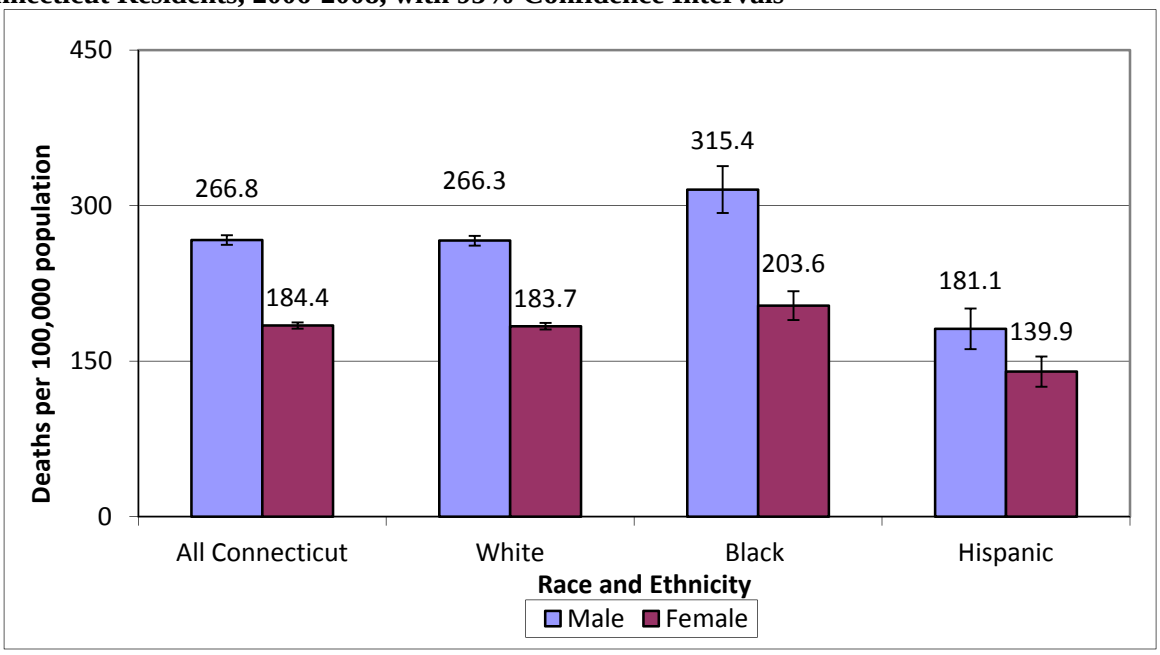
Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

Mortality by Gender, Race and Ethnicity

Cardiovascular Disease

The Connecticut resident CVD mortality rates differ by gender, race and ethnicity[†] with Black Connecticut residents having the highest CVD mortality rates (2006-2008 data). The CVD mortality rates of Black males and females are significantly higher than those of White males ($p<0.001$) and females ($p<0.05$), respectively. Black males and females also have significantly higher CVD mortality rates compared with Hispanic males and females ($p<0.001$ for both comparisons).[3] Conversely, Hispanic males and females have significantly lower mortality rates due to CVD than White males and females ($p<0.001$ for both comparisons) [Figure 6].[3] CVD mortality rates declined significantly for all subpopulation groups between 1999-2001 and 2006-2008 ($p<0.001$ for White and Black males and females; $p<0.005$ for Hispanic males; $p<0.01$ for Hispanic females) [data not shown].[3]

Figure 6. Age-adjusted Mortality Rates for Cardiovascular Disease by Gender, Race and Ethnicity, Connecticut Residents, 2006-2008, with 95% Confidence Intervals



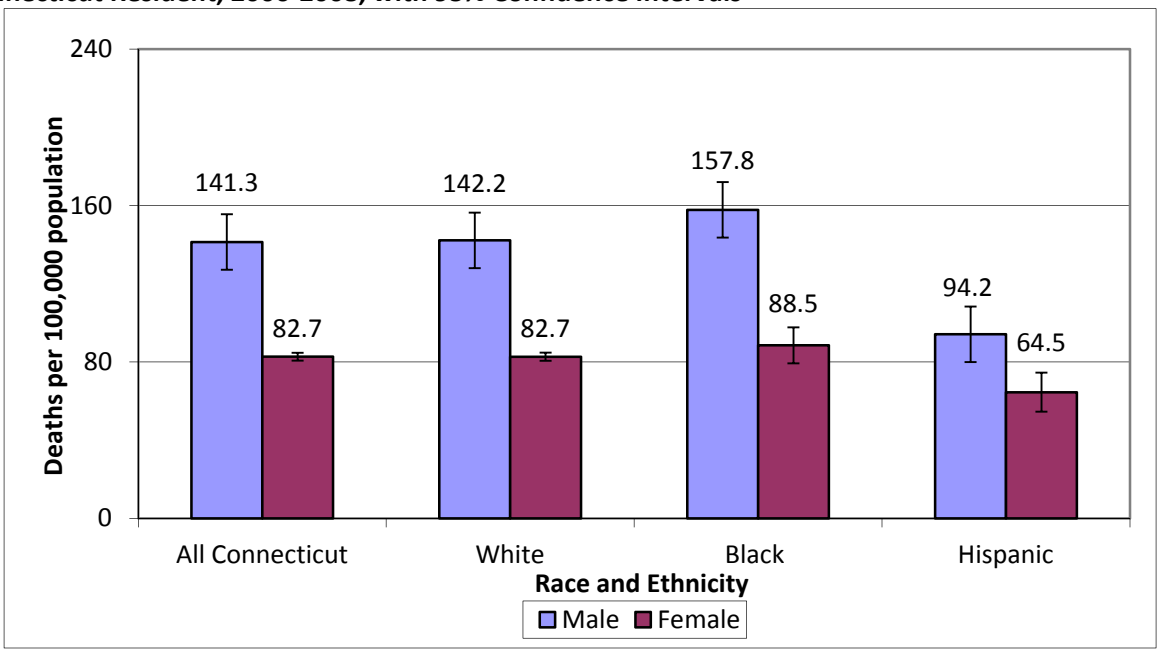
Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

[†] Throughout this report racial groupings (e.g., "Black", "White") exclude persons of Hispanic ethnicity. A Hispanic ethnicity category is included in figures and tables reflecting data separate from race categories. Therefore, the modifier "non-Hispanic" is assumed.

Coronary Heart Disease

The CHD mortality rates differ somewhat by gender, race and ethnicity (2006-2008 data). Hispanic males and females have significantly lower CHD mortality rates than White males and females as well as Black males and females ($p < 0.001$ for males; $p<0.005$ for females) [Figure 7].[3] The CHD mortality rates of White males and females do not differ significantly from the rates of Black males and females (Figure 7).[3] CHD mortality rates declined significantly for all subpopulation groups in Connecticut between 1999-2001 and 2006-2008 ($p<0.01$ for Hispanic females; $p<0.001$ for other comparisons) [data not shown].[3]

Figure 7. Age-adjusted Mortality Rates for Coronary Heart Disease by Gender, Race and Ethnicity, Connecticut Resident, 2006-2008, with 95% Confidence Intervals

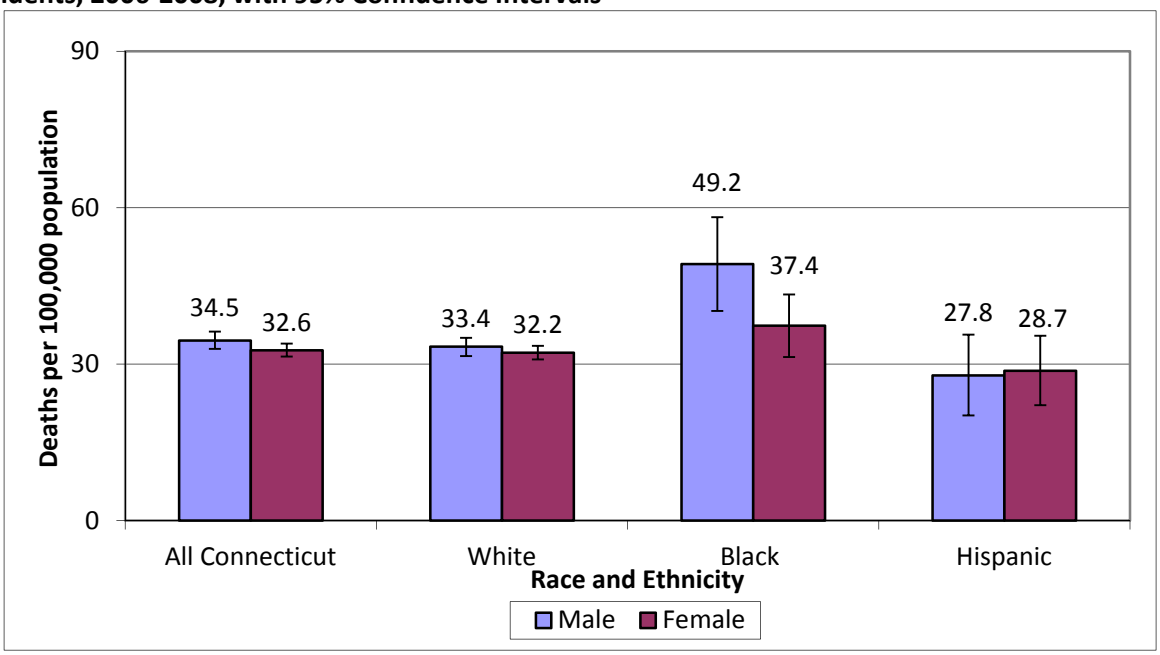


Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

Stroke

Stroke mortality rates differ somewhat by gender, race and ethnicity (2006-2008). Black males have a significantly higher stroke mortality rate than White ($p<0.005$) and Hispanic males ($p<0.05$) [Figure 8].[3] However, the stroke mortality rates for Hispanic and White males do not differ significantly.[3] Likewise, the stroke mortality rates for White, Black, and Hispanic females do not differ significantly (Figure 8).[3] Stroke mortality rates declined significantly for White males ($p<0.001$), White females ($p<0.001$) and Black females ($p<0.005$) between 1999-2001 and 2006-2008 [data not shown].[3]

Figure 8. Age-adjusted Mortality Rates for Stroke by Gender, Race and Ethnicity, Connecticut Residents, 2006-2008, with 95% Confidence Intervals

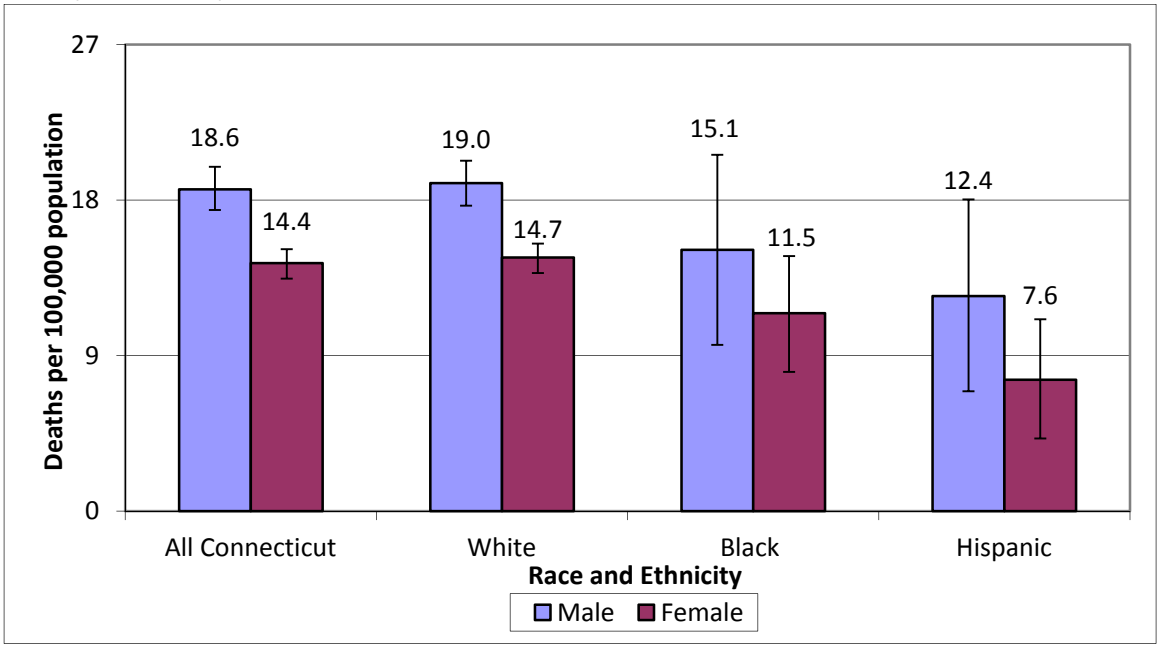


Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

Heart failure

HF mortality rates vary little by gender, race and ethnicity (2006-2008 data). While the HF mortality rate of White females is significantly higher than the rate of Hispanic females ($p<0.005$), the HF mortality rate of White and Black females does not differ significantly [Figure 9].[3] The difference in the mortality rates of Black and Hispanic females does not reach statistical significance.[3] Also, the HF mortality rates of White, Black, and Hispanic males do not differ significantly [Figure 9].[3] White females and the overall Black Connecticut population experienced a statistically significant decline in the HF mortality rate between 1999-2001 and 2006-2008 ($p<0.05$ for both comparisons) [data not shown].[3]

Figure 9. Age-adjusted Mortality Rates for Heart Failure by Gender, Race and Ethnicity, Connecticut Residents, 2006-2008, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

Premature Mortality by Gender, Race and Ethnicity

Premature mortality[‡], defined as the "years of potential life lost before age 75," focuses on deaths that occur at younger ages. For example, a person who dies at age 45 is considered to have lost 30 years of life, and a person who dies at 70 is considered to have lost 5 years of life.[9] Premature mortality is important because it emphasizes the years of productive life that are lost to society.

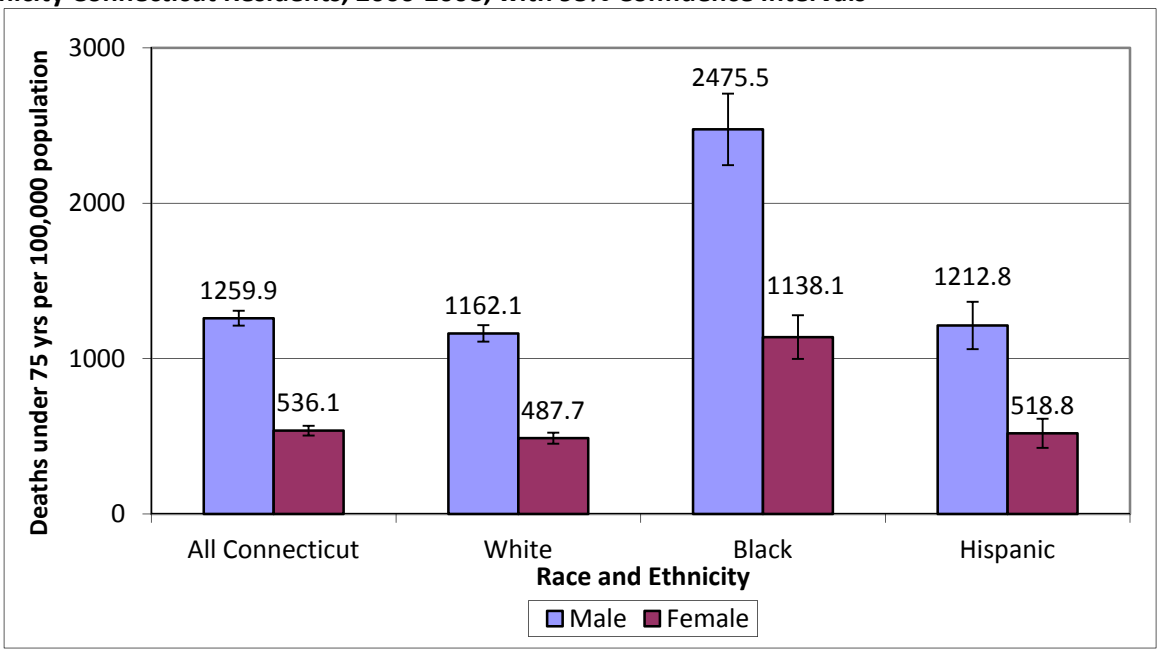
Cardiovascular Disease

CVD premature mortality rates differ by race and ethnicity as well as gender (2006-2008 data). Black males and females have significantly higher CVD premature mortality rates compared with White and Hispanic males and females ($p < 0.001$ for all comparisons) [Figure 10].[3] However, the CVD premature mortality rates of White males and females do not differ significantly from the rates of Hispanic males and females.[3] Also, males have significantly higher CVD premature mortality rates than females ($p<0.001$) (Figure 10).[3]

The CVD premature mortality rate declined significantly for the overall Connecticut population between 1999-2001 and 2006-2008 ($p<0.001$) [data not shown]. Similarly, CVD premature mortality rates declined significantly for White males ($p<0.001$), White females ($p<0.001$), Black females ($p<0.001$), Hispanic males ($p<0.05$), and Hispanic females ($p<0.05$) [data not shown]. CVD premature mortality rates for Black males did not change significantly from 1999-2001 to 2006-2008 [data not shown].[3]

[‡] The premature mortality rates presented in this report are age-adjusted "Years of Potential Life Lost (YPLL) under 75 years". Age-adjusted rates were computed by the direct method using the 2000 U.S. standard million population and Connecticut resident death records.

Figure 10. Age-adjusted Premature Mortality Rates for Cardiovascular Disease by Gender, Race and Ethnicity Connecticut Residents, 2006-2008, with 95% Confidence Intervals



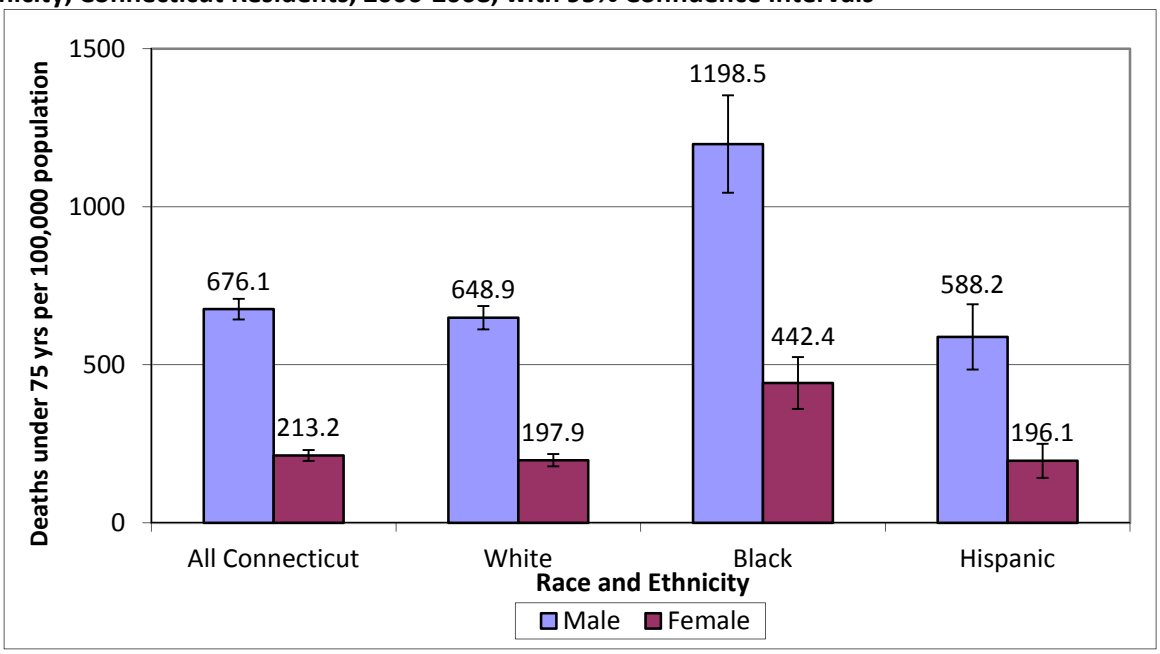
Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

Coronary Heart Disease

CHD premature mortality rates differ by race, ethnicity, and gender (2006-2008 data). The CHD premature mortality rates of Black males and females are significantly higher than those of White and Hispanic males and females ($p<0.001$ for all comparisons) [Figure 11].[3] However, the CHD premature mortality rates of White and Hispanic residents do not differ significantly.[3] Also, males have a significantly higher CHD premature mortality rate than females ($p<0.001$) [Figure 11].[3]

The CHD premature mortality rate declined significantly for the overall Connecticut population between 1999-2001 and 2006-2008 ($p<0.001$) [data not shown]. Similarly, CHD premature mortality rates declined significantly for all subpopulation groups (White males, $p<0.001$; White females $p<0.001$; Black males, $p<0.05$; Black females, $p<0.001$; Hispanic males, $p<0.005$; and Hispanic females, $p<0.05$) [data not shown].[3]

Figure 11. Age-adjusted Premature Mortality Rates for Coronary Heart Disease by Gender, Race and Ethnicity, Connecticut Residents, 2006-2008, with 95% Confidence Intervals



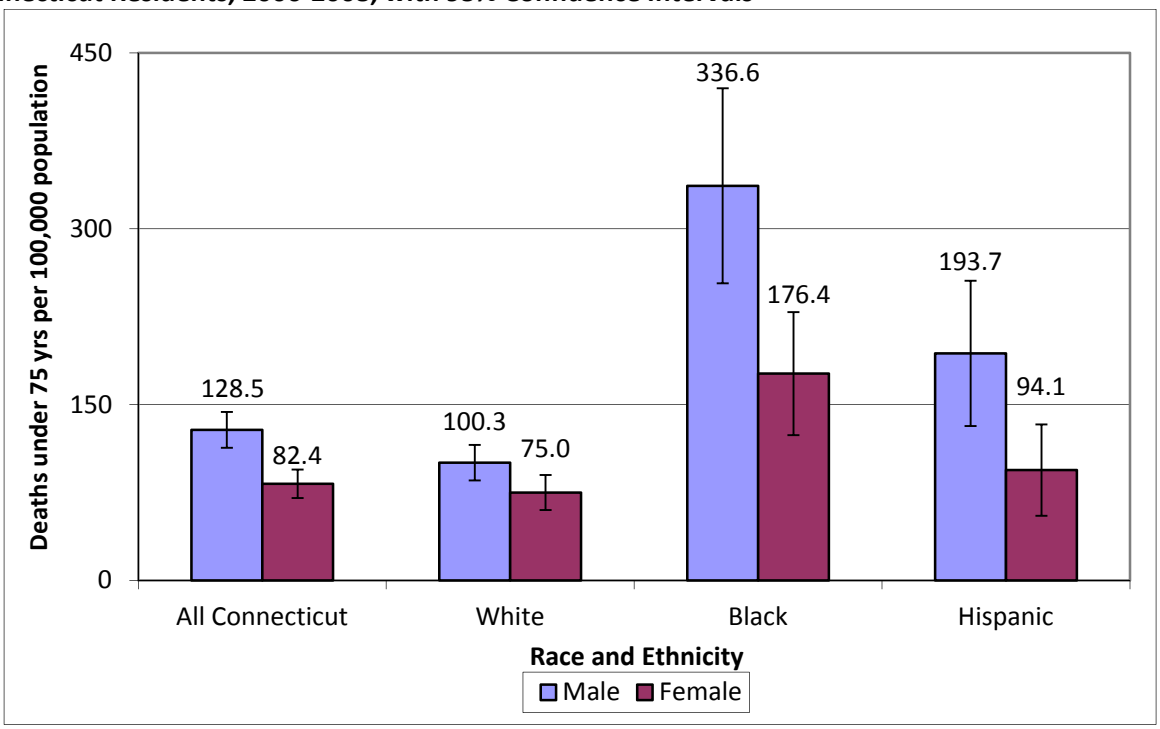
Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

Stroke

Stroke premature mortality rates vary by gender, race and ethnicity (2006-2008 data). Overall, males have a significantly higher stroke premature mortality rate than females ($p<0.005$) [Figure 12].[3] The stroke premature mortality rates of Black and Hispanic males are significantly higher than that of White males ($p<0.001$ for Black and White male comparison; $p<0.05$ for Hispanic and White male comparison) [Figure 12].[3] However, the stroke premature mortality rates of Hispanic and Black males do not differ significantly.[3] While Black females have a significantly higher stroke premature mortality rate than White females ($p<0.005$), the stroke premature mortality rates of Hispanic and White females are not statistically different [Figure 12].[3] Also, the stroke premature mortality rates of Black and Hispanic females do not differ significantly.[3]

The stroke premature mortality rate declined significantly for the overall Connecticut population ($p<0.005$), White males ($p<0.05$), and White females ($p<0.05$) between 1999-2001 and 2006-2008 ($p<0.005$) [data not shown]. The decline in the stroke premature mortality rates for Black and Hispanic males and females do not reach statistical significance (data not shown).[3]

Figure 12. Age-adjusted Premature Mortality Rates for Stroke by Gender, Race and Ethnicity, Connecticut Residents, 2006-2008, with 95% Confidence Intervals

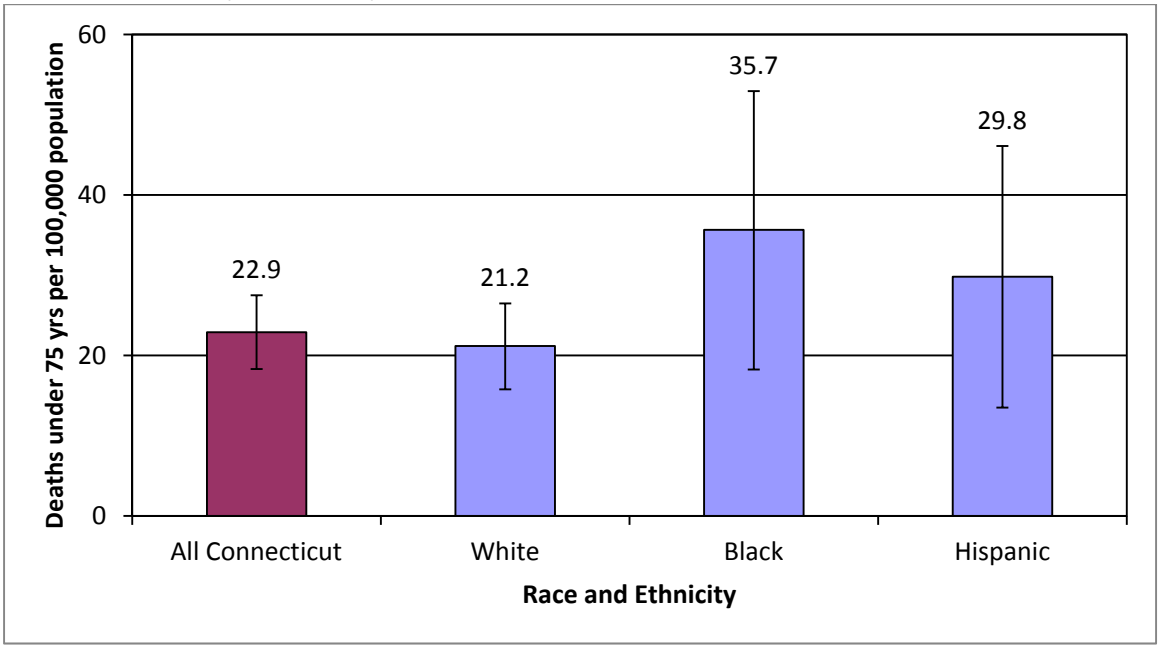


Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

Heart failure

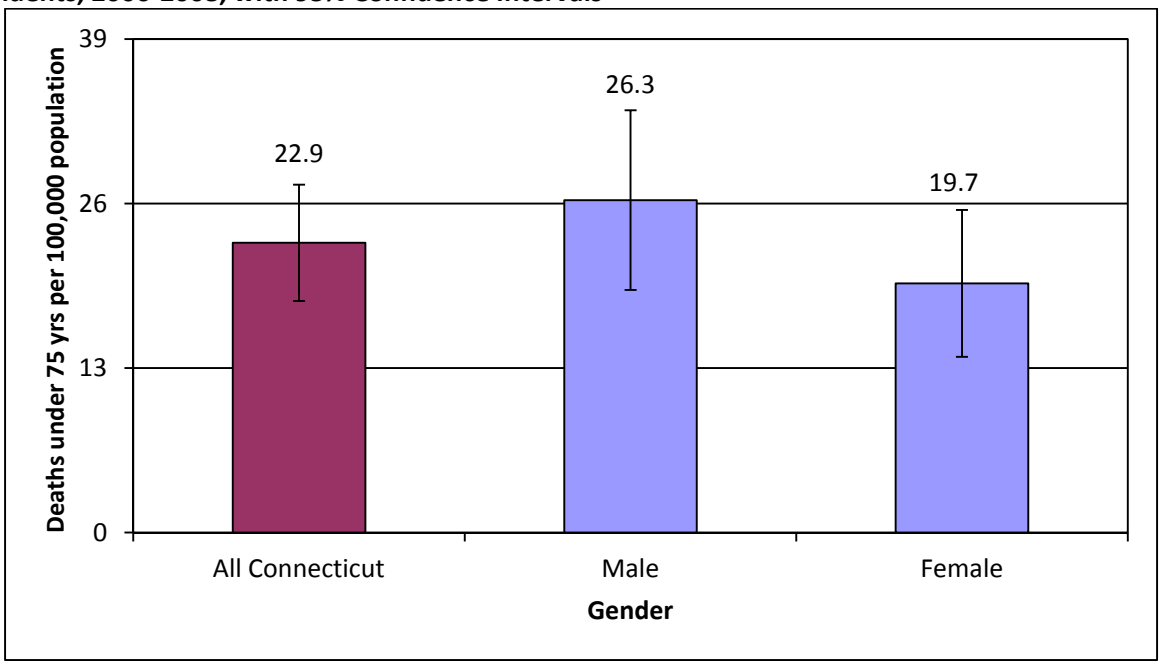
The Connecticut resident HF premature mortality rate does not differ significantly by gender or race and ethnicity (Figure 13 and Figure 14) [2006-2008 data].[3] HF premature mortality rates did not decline significantly between 1999-2001 and 2006-2008 [data not shown].[3]

Figure 13. Age-adjusted Premature Mortality Rates for Heart Failure by Gender, Race and Ethnicity, Connecticut Residents, 2006-2008, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

Figure 14. Age-adjusted Premature Mortality Rates for Heart Failure by Gender, Connecticut Residents, 2006-2008, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, Vital Records Mortality Files, 2010.

MORBIDITY

There were 59,664 Connecticut resident discharges from Connecticut hospitals for all CVD in 2008. This represents 18% of all hospital discharges (excluding pregnancy and childbirth related discharges) and 23% of all hospital billing charges in the state.[10] Approximately 26% of all CVD discharges are due to CHD, 12% are for stroke, and 18% are for HF. The median length of stay for CHD, stroke, and HF is two, three, and four days, respectively. The median length of stay for all hospital discharges in Connecticut is three days.[10]

Hospitalizations by Gender

Hospitalization rates[§] vary by gender (2008 data). Males have significantly higher rates of hospitalizations for all CVD, CHD, stroke, and HF compared with females ($p < 0.001$). More females than males, however, are hospitalized for stroke and HF [Table 3].[10]

Table 3. Hospitalizations and Age-adjusted Hospitalization Rates (AAHR) for Cardiovascular Diseases per 100,000 Population, Connecticut Residents by Gender, 2008

Diagnostic Group	All		Male		Female	
	Discharges	AAHR	Discharges	AAHR	Discharges	AAHR
All Cardiovascular Diseases	59,664	1,483.1	31,748	1,862.9	27,916	1,184.1
Coronary Heart Disease	15,779	392.0	9,877	559.2	5,902	254.2
Stroke	7,413	183.6	3,626	216.1	3,787	158.1
Heart failure	10,725	259.9	5,331	326.8	5,394	213.8

Source: Connecticut Department of Public Health, Connecticut Hospital Discharge Abstract and Billing Data Base, 2010.

[§]Hospitalization rates were calculated using 2008 Connecticut resident hospitalization discharge data and were age-adjusted based on the 2000 U.S. standard million population.

Hospitalization Rates by Race and Ethnicity

Hospitalization rates differ by race and ethnicity (2008 data). Black residents have significantly higher rates of hospitalizations for CVD, stroke, and HF than both White and Hispanic residents ($p<0.001$ for all comparisons). Black residents' rate of hospitalizations for CHD, however, is not significantly different than that of White and Hispanic residents.[10] Hispanic residents have significantly higher hospitalization rates for CVD ($p<0.001$) and CHD ($p<0.01$) than White residents. In contrast, Hispanic residents have a significantly lower rate of hospitalization for HF compared with White residents ($p<0.05$). Furthermore, the rates of hospitalization for stroke of Hispanic and White residents are not significantly different (Table 4).[10]

Table 4. Hospitalizations and Age-adjusted Hospitalization Rates (AAHR) for Cardiovascular Diseases per 100,000 Population, Connecticut Residents by Race and Ethnicity, 2008

Diagnostic Group	All		White, non-Hispanic		Black, non-Hispanic		Hispanic	
	Discharges	AAHR	Discharges	AAHR	Discharges	AAHR	Discharges	AAHR
All Cardiovascular Diseases	59,664	1,483.1	48,395	1,380.4	5,555	2,114.2	3,667	1,713.6
Coronary Heart Disease	15,779	392.0	13,106	378.2	992	375.9	954	427.2
Stroke	7,413	183.6	6,033	170.5	700	270.5	403	195.7
Heart failure	10,725	259.9	8,568	231.0	1,185	463.9	731	390.1

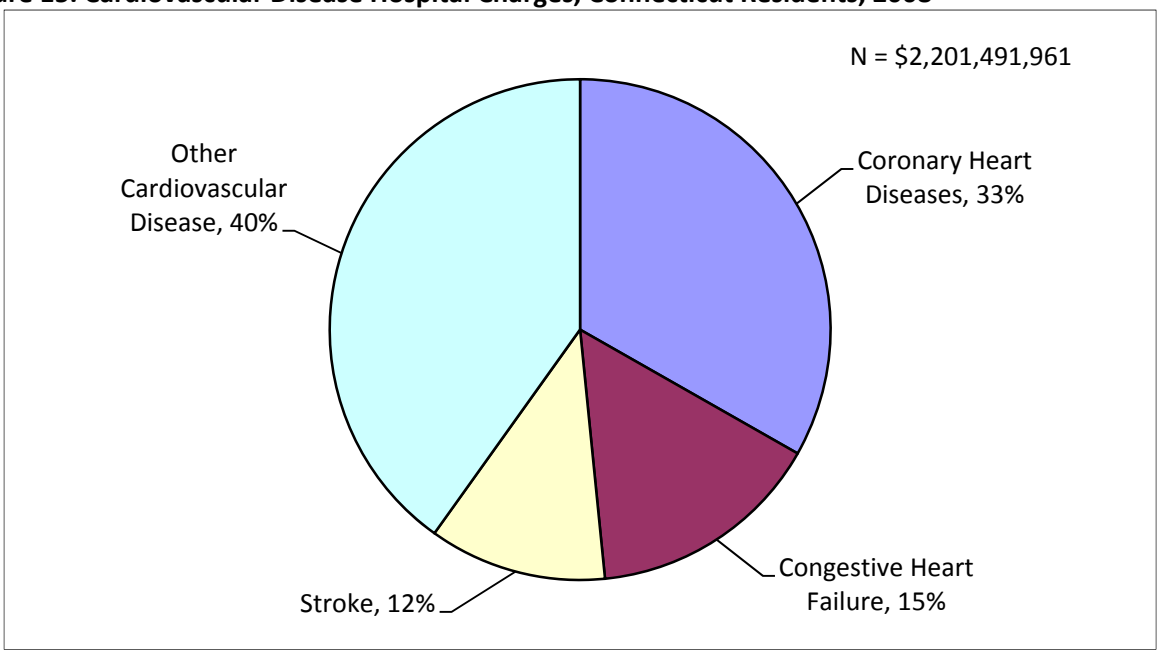
Source: Connecticut Department of Public Health, Connecticut Hospital Discharge Abstract and Billing Data Base, 2010.

Economic Costs

The estimated national annual cost for the medical management of CVD was $503.2 billion in 2010, or about $1600 per person.[2] This estimate includes direct medical costs and indirect costs. The indirect cost of CVD is associated with lost productivity from illness and premature death. Also, CVD are major causes of disability, limiting an individual's ability to live independently and negatively impacting the quality of life for individuals and families. For these reasons, CVD can incur enormous indirect costs. Assuming that disease rates and per person costs are the same in Connecticut as they are nationwide, the estimated economic burden of CVD in the state is about $5.8 billion. A large portion of these costs is attributable to inpatient hospitalizations.

Total Connecticut CVD hospital charges in 2008 were about $2.2 billion, with a median charge of $23,172 (Figure 15). About 33% of total CVD hospitalization charges were for CHD, 12% were for stroke, and 15% were for HF.[10] Median hospital charges were $34,792 for CHD, $19,772 for stroke, and $17,408 for HF. In contrast, the median charge for all hospital discharges in Connecticut was $16,727.[10]

Figure 15. Cardiovascular Disease Hospital Charges, Connecticut Residents, 2008



Source: Connecticut Department of Public Health, Connecticut Hospital Discharge Abstract and Billing Data Base, 2010.

RISK FACTORS

Risk factors for CVD may be non-modifiable (e.g., increasing age or family history) or modifiable (high blood pressure, high cholesterol, smoking, diabetes, obesity, physical inactivity) [Table 5]. Increasing age is a key risk factor for heart disease, stroke, and HF.[1] About 86% of all CVD deaths in Connecticut occur among those aged 65 years and older. About 85% of all CHD deaths, 90% of all stroke deaths, and 96% of all HF deaths in Connecticut occur among persons aged 65 years and older.[7] For men and women, major increases in the CVD mortality rate begin in the 35-to-44-year-old age group.[4] A family history of heart disease and stroke increases one's risk of developing these diseases. A combination of inherited characteristics and behavioral patterns (e.g. similar dietary, smoking, and activity habits) are thought to partially explain increased risk within families.[11]

Lower socioeconomic position (SEP) is an important risk marker for CVD. SEP is commonly measured by personal income, household income, or educational attainment level. Persons of lower SEP have higher CVD morbidity and mortality than do middle- or upper-income persons. Behavioral risk factors such as smoking, hypertension, and obesity are more prevalent in persons of lower SEP and may explain some of the observed disparity; however, other factors, like neighborhood socioeconomic environment, appear to have effects on individuals' risk for CVD.[1] Low-income neighborhood environments may contribute to increased CVD risk and poorer health outcomes because of such factors like poorer air quality, fewer food choices, and lower quality and/or lack of public services. Persons with lower incomes tend to have less access to and/or less effectively use preventive health services that are important to the early detection and treatment of hypertension.[12] While low-socioeconomic position may be considered "modifiable" in the sense that people can move in and out of poverty during a lifetime or over generations, it is not usually within a given individual's control to change his or her social position or neighborhood environment.

Table 5. Risk Factors for Cardiovascular Disease

Modifiable Risk Factors	Non-Modifiable Risk Factors
• High blood pressure • High cholesterol • Smoking • Diabetes • Obesity • Physical inactivity	• Increasing age • Family history

Modifiable Risk Factors

Current Connecticut Behavioral Risk Factor Surveillance System (BRFSS)[**] data show that about one out of three Connecticut adults report having one modifiable risk factor for CVD.[14] Following are summaries of the six main risk factors (high blood pressure, high blood cholesterol, tobacco use, diabetes, obesity, and physical inactivity) for CVD.

High Blood Pressure

High blood pressure (HBP) is a major risk factor for heart attack and the most important modifiable risk factor for stroke. People with elevated blood pressure (≥140 mmHg systolic / 90 mmHg diastolic) are 2 to 4 times more likely to develop CHD as are people with normal blood pressure (<120 mmHg systolic / 80 mmHg diastolic).[1] Studies have found that individuals with a normal blood pressure have approximately half the lifetime risk of stroke compared to those with high blood pressure.[13]

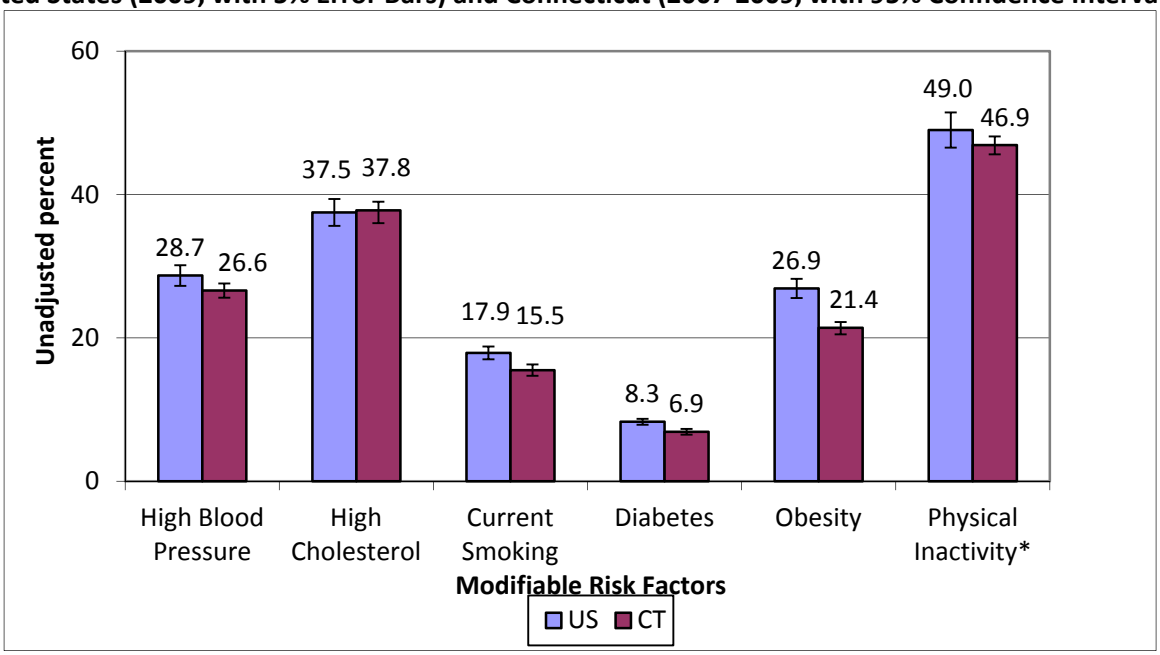
Approximately 27% of Connecticut adults report having HBP (2007-2009 data) compared with about 29% of adults nationwide (2009 data) (Figure 16).[14, 15] The risks for hypertension-related CVD increase markedly with age, as does the prevalence of hypertension, and drug treatment for HBP.[13] For example, 15.4% of Connecticut adults aged 35-44 years report having HBP compared with 57.8% of Connecticut adults aged 65 years and older ($p<0.001$) [data not shown].[14]

The rates of HBP also differ by gender. Approximately 27.4% of Connecticut males have HBP compared with 22.5% of females ($p<0.001$) [data not shown].[14]

The prevalence of HBP varies by race and ethnicity. Black Connecticut adults are more likely to have HBP than White and Hispanic Connecticut adults ($p<0.001$ for both comparisons). The rates of HBP among White and Hispanics adults do not differ significantly. About 25% of White, 36% of Black, and 22% of Hispanic adults report that they were told they had hypertension (Figure 17).[14]

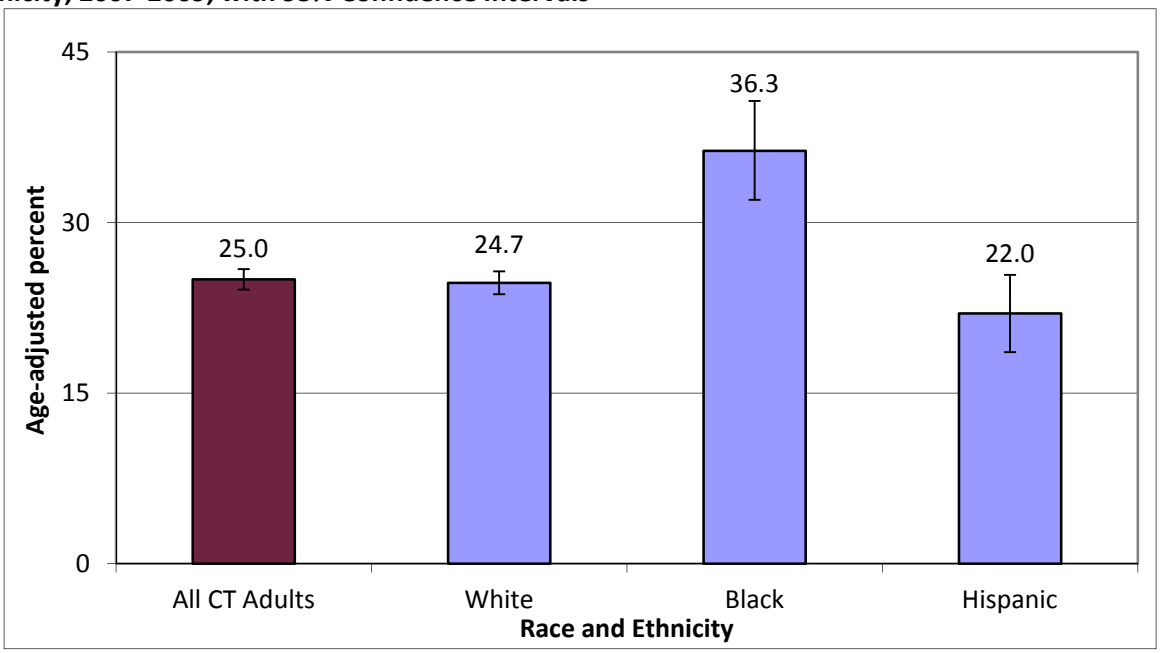
[**] Unless otherwise stated, the BRFSS data presented in this report are based on 2007-2009 survey responses from non-institutionalized Connecticut adults.

Figure 16. Prevalence of Modifiable Risk Factors for Cardiovascular Diseases among Adults in the United States (2009, with 5% Error Bars) and Connecticut (2007-2009, with 95% Confidence Intervals)



Sources: Centers for Disease Control and Prevention, Behavioral Risk Factor Surveillance System (BRFSS), 2010. Connecticut Department of Public Health, BRFSS, 2010.
*Participated in less than the recommended amount of physical activity.

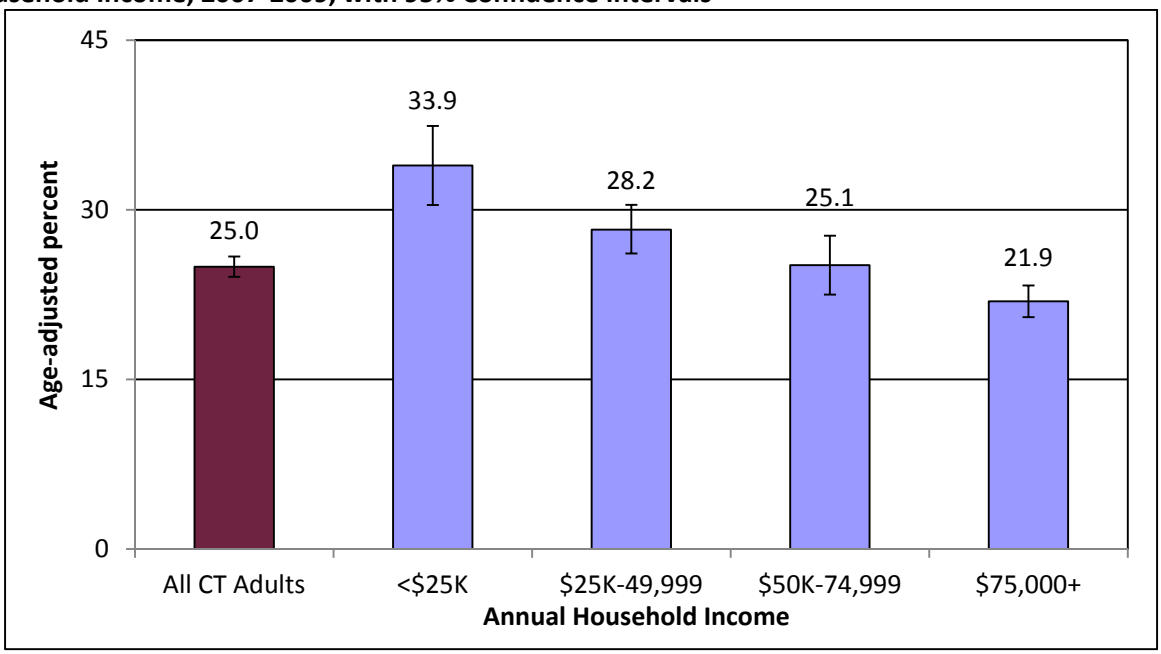
Figure 17. Age-adjusted Prevalence of High Blood Pressure among Connecticut Adults by Race and Ethnicity, 2007-2009, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, BRFSS, 2010.

Connecticut adults with lower annual household incomes tend to have a higher prevalence of HBP compared to Connecticut adults with higher annual household incomes. For example, 33.9% of adults with an annual household income less than $25,000 have diagnosed HBP compared to 21.9% of adults with annual household income of at least $75,000 ($p<0.001$) [Figure 18].[14]

Figure 18. Age-adjusted Prevalence of High Blood Pressure among Connecticut Adults by Annual Household Income, 2007-2009, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, BRFSS, 2010.

High Blood Cholesterol

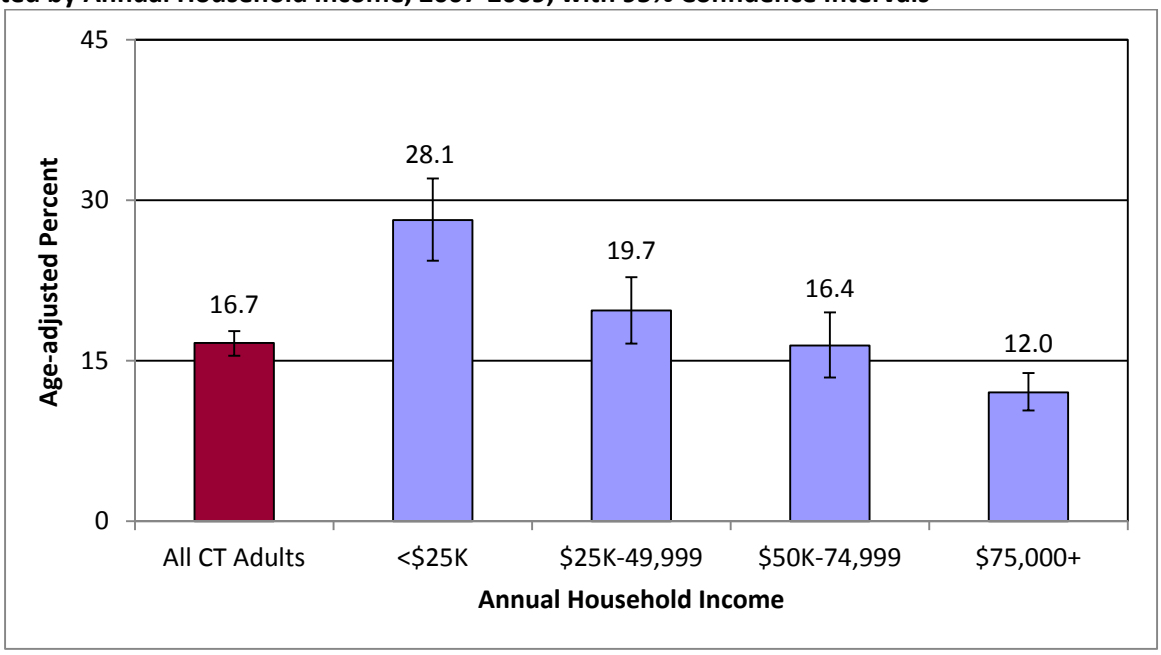
High blood cholesterol (HBC) is considered a major risk factor for CHD.[16, 17] Dyslipidemias, or an abnormal amount of lipids (e.g. high blood cholesterol) in the blood, were not traditionally regarded as a risk factor for stroke; however, a recent meta-analysis of statin therapy found that treatment of dyslipidemia decreases the risk of nonhemorrhagic stroke.[1] Control and reduction of HBC is important. A 10% decrease in total blood cholesterol levels may reduce the incidence of CHD by as much as 30%.[18]

About 38% of adults in Connecticut (2007-2009 data) and nationwide (2009 data) were told they had HBC (Figure 16).[14, 15] The prevalence of HBC increases with age. For example, 38.1% of Connecticut's adults aged 45-54 years report having HBC compared with 53.4% of Connecticut's adults aged 65 years and older ($p<0.001$) [data not shown].[14]

The prevalence of HBC also varies by gender. Approximately, 39.2% of Connecticut males have HBC compared with 29.7% of females ($p<0.001$) [data not shown]. [14]

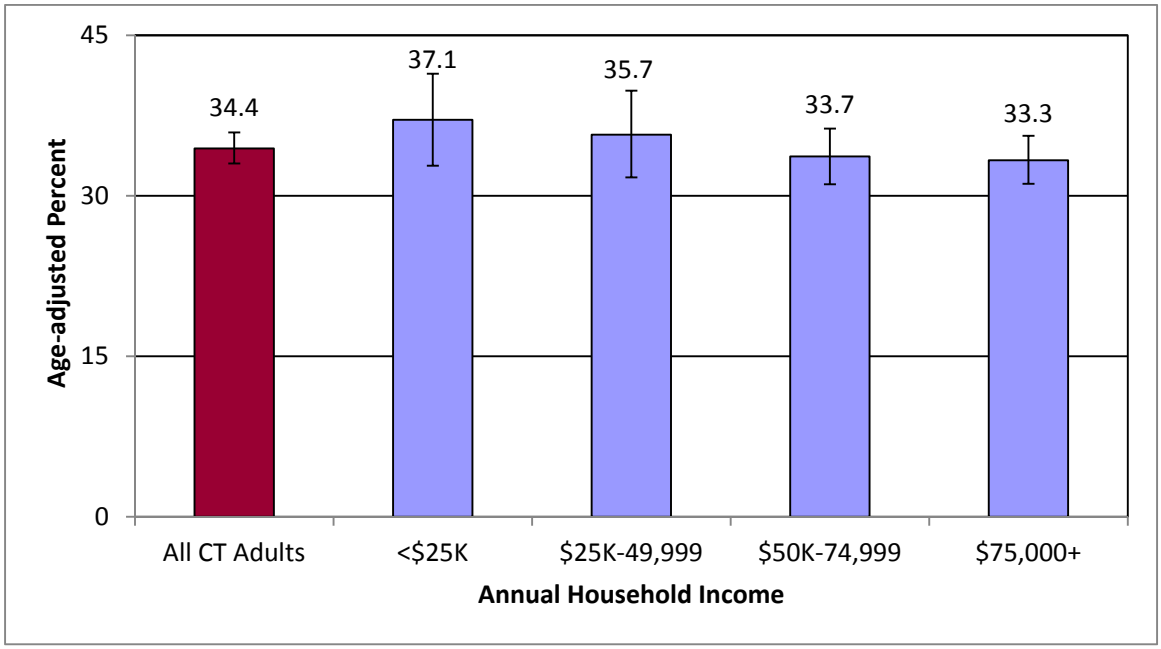
Connecticut adults compare favorably to adults nationwide in terms of cholesterol screening. About 82% of Connecticut adults report having had their blood cholesterol screened within the last five years (2007-2009 data) compared with 77% of adults in the U.S. (2009 data).[14, 15] Connecticut adults with lower incomes are more likely to report that they have never had their blood cholesterol tested compared to adults with higher incomes. For example, adults with annual household incomes less than $25,000 are significantly more likely to report that they have never had their blood cholesterol tested compared to individuals with annual household incomes of $75,000 or more ($p<0.001$) [Figure 19]. In contrast, the prevalence of HBC does not differ significantly by annual household income [Figure 20].[14]

Figure 19. Age-adjusted Percentage of Connecticut Adults Who Have Never Had Their Cholesterol Tested by Annual Household Income, 2007-2009, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, BRFSS, 2010.

Figure 20. Age-adjusted Percentage of Connecticut Adults Who had Their Cholesterol Tested in the Past 5 Years and Were Told It was High by Annual Household Income, 2007-2009, with 95% Confidence Intervals

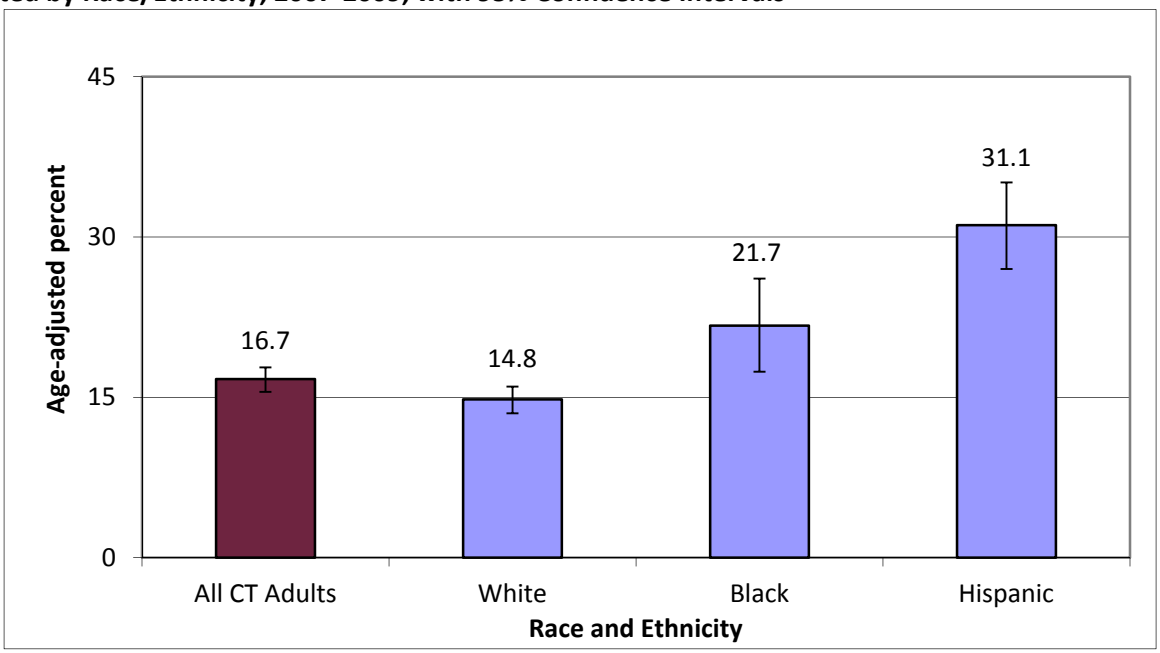


Source: Connecticut Department of Public Health, BRFSS, 2010.

Black and Hispanic adults are significantly more likely than White adults to report never having had their blood cholesterol tested ($p<0.05$ for Black and White comparison; $p<0.001$ for Hispanic and White comparison). Hispanic adults are also more likely than Black adults to report never having had their blood cholesterol tested ($p<0.05$). An estimated 14.8% of White, 21.7% of Black, and 31.1% of Hispanic adults report never having had their blood cholesterol tested [Figure 21]. In contrast, the prevalence of HBC does not differ significantly by race and ethnicity [data not shown].[14]

The rates of never having had blood cholesterol tested do not differ significantly by gender. Approximately, 16.9% of males and 16.4% of females in Connecticut have never had their blood cholesterol tested [data not shown].[14]

Figure 21. Age-adjusted Percentage of Connecticut Adults Who Have Never Had Their Cholesterol Tested by Race/Ethnicity, 2007-2009, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, BRFSS, 2010.

Smoking

Cigarette smoking is a major modifiable risk factor for CVD. Smoking causes reduced blood vessel elasticity by increasing arterial wall stiffness. Smoking increases the risk of heart attack two-fold. Smokers have higher CHD mortality rates than non-smokers and the risk of death increases with greater number of cigarettes smoked. Current smokers have more than twice the risk of stroke compared with those who have never smoked. People who stop smoking decrease their stroke risk and their risk of CHD mortality.[1]

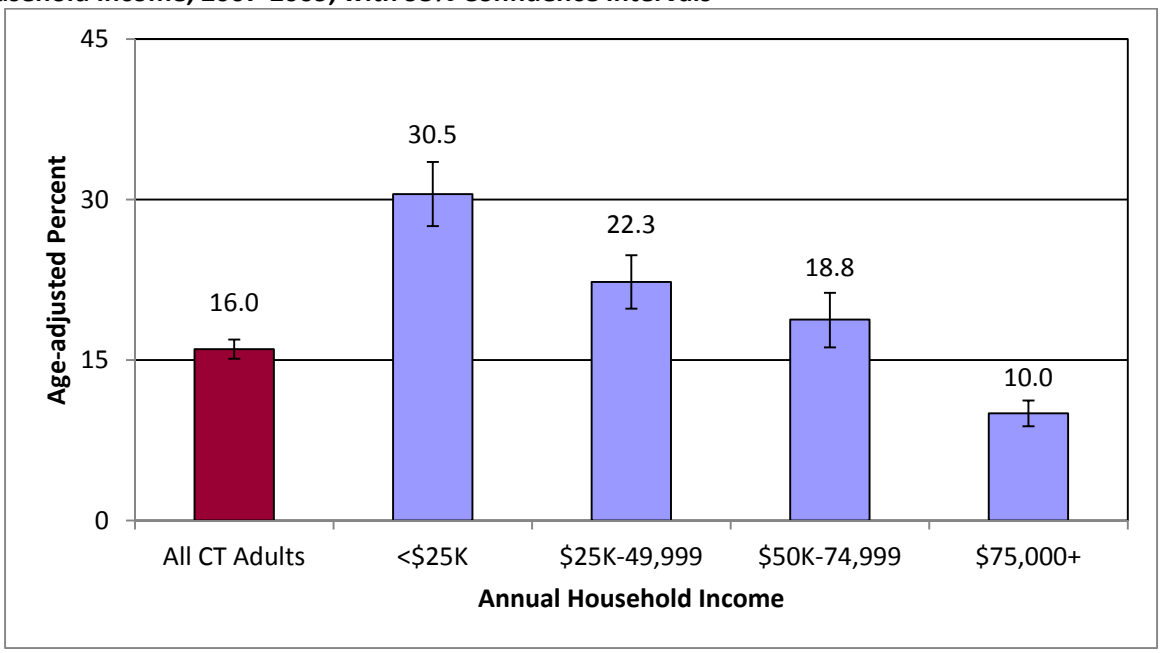
About 16% of Connecticut adults report being current smokers (2007-2009 data) compared with about 18% of adults nationwide (2009 data) [Figure 16].[14, 15] According to the 2009 Connecticut School Health Survey (CSHS), 17.8% of high school students report being current smokers.[19]

Among adults, current smokers are more likely to be younger. For example, an estimated 22% of Connecticut adults aged 18 to 24 years old are current smokers compared with 14% of those aged 55 to 64 ($p<0.01$), and 6% of those aged 65 and older ($p<0.001$) [data not shown].[14] Smokers are also more likely to be individuals who have lower incomes and are less educated. For instance, about 31% of Connecticut's adults with annual household incomes under $25,000 are current smokers, compared to 10% of adults with annual household incomes of $75,000 or more ($p<0.001$) [Figure 22].[14] Similarly, about 31% of adults with less than a high school education report being current smokers compared to about 9% of adults who graduated from college ($p<0.001$) [data not shown].[14]

The rates of smoking do not differ significantly by gender. An estimated 16.8% of adult males and 15.2% of adult females are current smokers while an estimated 19.0% of high school males and 16.5% of high school females are current smokers (data not shown).[14, 19]

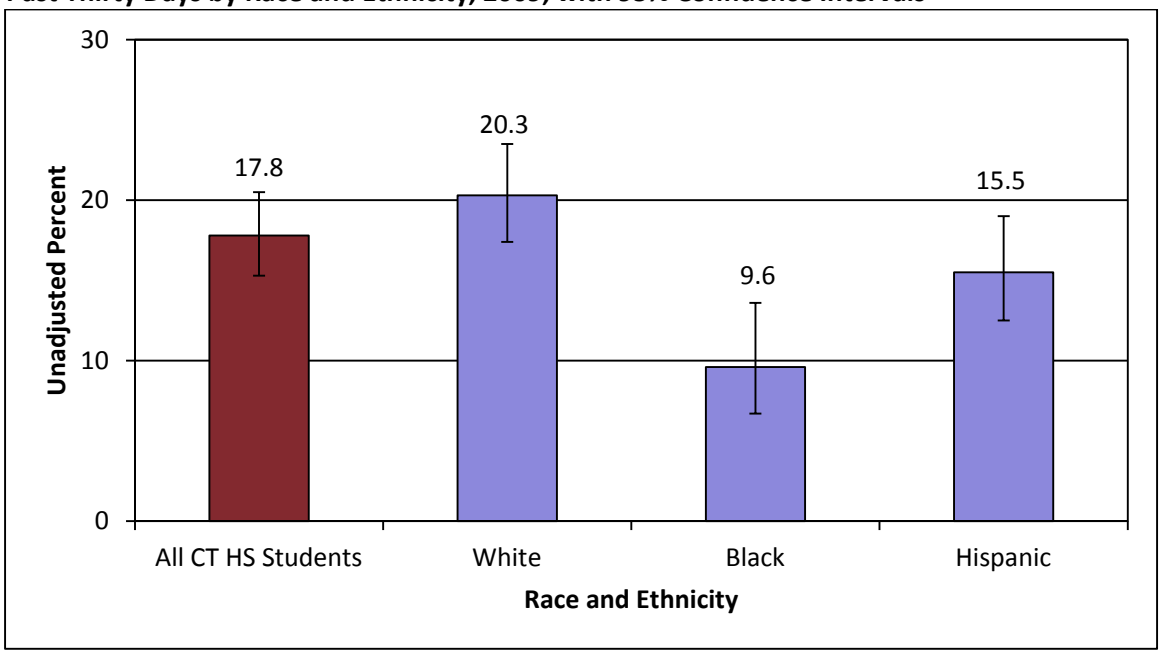
Among Connecticut adults, smoking rates do not differ significantly by race and ethnicity. An estimated 15.8% of White, 19.1% of Black, and 15.6% Hispanic adults report being current smokers [data not shown].[14] However, the rates of smoking among high school students do vary by race and ethnicity. White Connecticut high school students are more likely to be current smokers than Black ($p<0.001$) and Hispanic ($p<0.05$) students. Also, Hispanic students are more likely than Black students to be current smokers ($p<0.05$) [Figure 23].[19]

Figure 22. Age-adjusted Percentage of Connecticut Adults Who Are Current Smokers by Annual Household Income, 2007-2009, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, BRFSS, 2010.

Figure 23. Percentage of Connecticut High School Students Who Smoked Cigarettes on One or More of the Past Thirty Days by Race and Ethnicity, 2009, with 95% Confidence Intervals



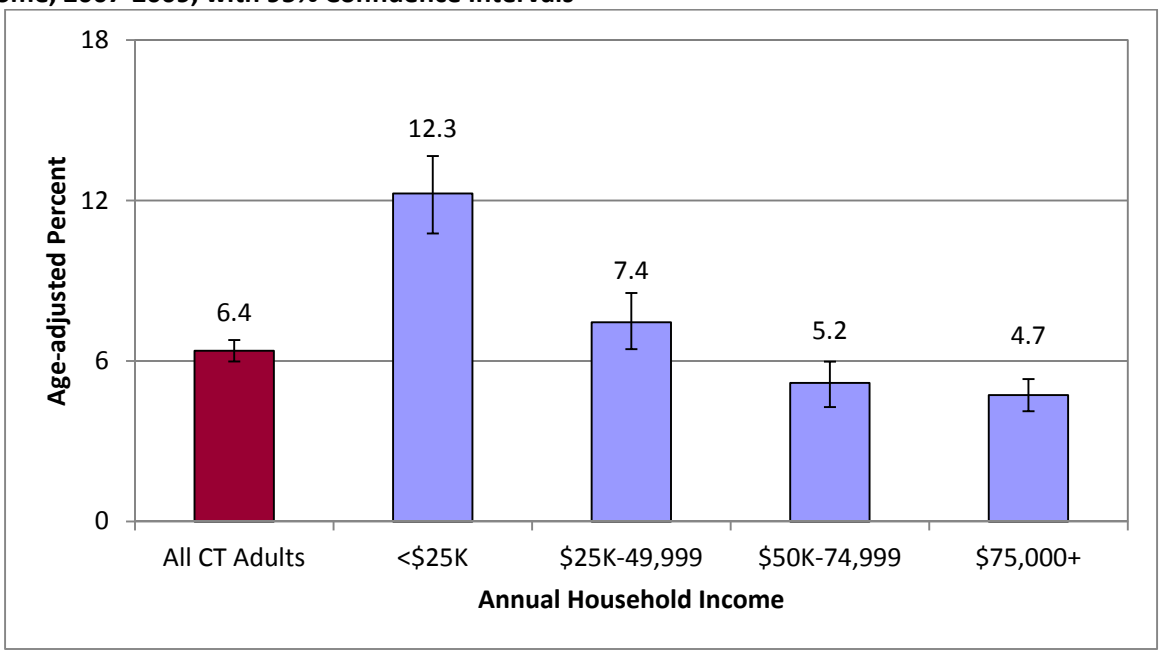
Source: Connecticut Department of Public Health, Youth Risk Behavior Surveillance System (YRBSS), 2010.

Diabetes

Diabetes has been recognized as a major risk factor for CVD. CVD is the primary cause of death for persons with diabetes, accounting for about 65% of the mortality. Individuals with diabetes are 2 to 4 times more likely to develop CHD and 2 to 5 times more likely to have a stroke than the rest of the population. People with diabetes often have HBP, HBC, and are overweight, further increasing their risk for CVD.[1]

An estimated 6.9% of Connecticut adults have diagnosed diabetes (2007-2009 data) compared with about 8% of adults nationwide (2009 data) [Figure 16].[14, 15] The prevalence of diabetes varies by gender, age, race and ethnicity, and SEP.[14, 20] Males are more likely to have diabetes than females. An estimated 7.3% of Connecticut males have diabetes compared with 5.7% of females ($p<0.005$) [data not shown].[14] Also, the prevalence of diabetes increases with age. Approximately 3% of adults aged 35-44 years report having diabetes compared to approximately 16.5% of adults aged 65 years and older ($p<0.001$) [data not shown].[14] Black and Hispanic adults have a significantly higher prevalence of diabetes compared with White adults ($p<0.001$ for both comparisons). The prevalence of diabetes among Black and Hispanic adults does not differ significantly. An estimated 5.6% of White, 14.9% of Black, and 10.5% of Hispanic adults report having diabetes [data not shown].[14] Adults with lower annual household incomes have a higher prevalence of diabetes compared to adults with higher annual household incomes. For example, approximately 12% of adults with annual household incomes under $25,000 report having diabetes, compared with about 5% of adults with household incomes over $75,000 ($p<0.001$) [Figure 24].[14]

Figure 24. Age-adjusted Prevalence of Diabetes among Connecticut Adults by Annual Household Income, 2007-2009, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, BRFSS, 2010.

Diabetes self-management education is essential because improperly controlled diabetes can result in CVD, kidney disease, blindness and loss of limb. It is, therefore, a particular concern that about 52% of Connecticut adults with diabetes report that they have never taken a course to manage the disease.[14]

Obesity

Body mass index (BMI), or weight adjusted for height, is a widely used screening method for obesity. For children and adolescents, BMI is compared to age- and gender-specific percentiles on the Centers for Disease Control and Prevention (CDC) growth charts. Children and adolescents with a BMI greater than or equal to the 85 percentile but less than the 95 percentile are considered overweight. Children and adolescents with a BMI greater than or equal to the 95 percentile are considered obese.[21] Medical guidelines for adults identify normal/desirable weight as a BMI under 25, overweight as a BMI of 25 to 29.9, and obese as a BMI of 30 or more. The prevalence of obesity has more than doubled over the past three decades in the United States.[21] The development of obesity involves social, behavioral, cultural, physiological, metabolic, and genetic factors. High calorie diets, along with less physical activity, have contributed to the obesity epidemic in our society.[21, 22]

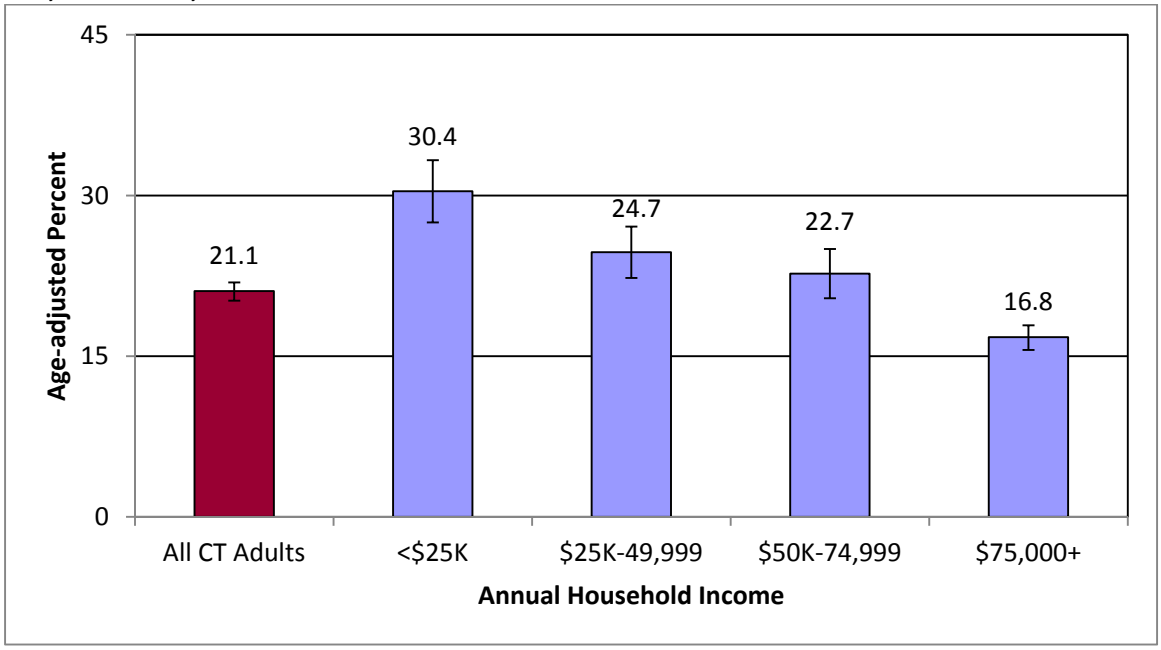
Obesity increases the risk of morbidity from hypertension, dyslipidemia, CHD, and stroke. All-cause mortality increases with increasing body weight.[22] Obesity is also an independent risk factor for CVD. The risk of ischemic stroke increases with increasing BMI. Studies have also suggested that body fat distribution may affect CHD risk. Upper body or abdominal fat seems to increase CHD risk regardless of BMI. Weight reduction can affect several of the modifiable risk factors for stroke thereby reducing the incidence of stroke.[1]

According to responses to the 2009 CSHS, an estimated 14.5% of Connecticut high school students were overweight and 10.4% were obese.[19] Obesity rates among high school students in Connecticut vary by gender and race and ethnicity. Male Connecticut high school students are significantly more likely to be obese than female high school students ($p<0.05$). An estimated 13.8% of male and 6.7% of female high school students in Connecticut are obese [data not shown].[19] Also, Hispanic Connecticut high school students have higher rates of obesity than both White ($p<0.001$) and Black ($p<0.05$) high school students. The difference in the rate of obesity among White and Black high school students does not reach statistical significance. An estimated 8.7% of White, 12.5% of Black, and 17% of Hispanic Connecticut high school students are obese [data not shown].[19]

An estimated 21% of Connecticut adults are obese (2007-2009 data) compared with about 27% of adults nationwide (2009 data) [Figure 16].[14, 15] Approximately 38% of Connecticut adults are overweight and 41% are neither overweight nor obese [data not shown].[14] Rates of obesity differ by SEP. For example, approximately 30% of adults with annual household incomes less than $25,000 are obese compared with 17% of those with annual household incomes over $75,000 ($p<0.001$) [Figure 25].[14] Rates of obesity also differ by race and ethnicity. Black and Hispanic adults are more likely to be obese than White adults ($p<0.001$ for both comparisons) [data not shown]. Black adults are also more likely to be obese than Hispanic adults ($p<0.05$). About 20% of White, 36% of Black, and 27% of Hispanic adults are obese [data not shown].[14] Furthermore, males are more likely to be obese than females. An estimated 27.9% of males are obese compared with 19.2% of females ($p<0.005$) [data not shown].[14] Additionally, older adults are more likely to be obese than younger adults. Approximately 11% of adults age 18-24 years are obese compared with 25% of adults aged 55-64 years ($p<0.001$) [data not shown].[14]

Obese adults are significantly more likely to report that they are in poorer health compared with non-obese adults. About 19% of adults who are obese report that they are in fair or poor health compared with about 9% of Connecticut adults who are not obese ($p<0.001$) [data not shown].[14]

Figure 25. Age-adjusted Prevalence of Obesity among Connecticut Adults by Annual Household Income, 2007-2009, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, BRFSS, 2010.

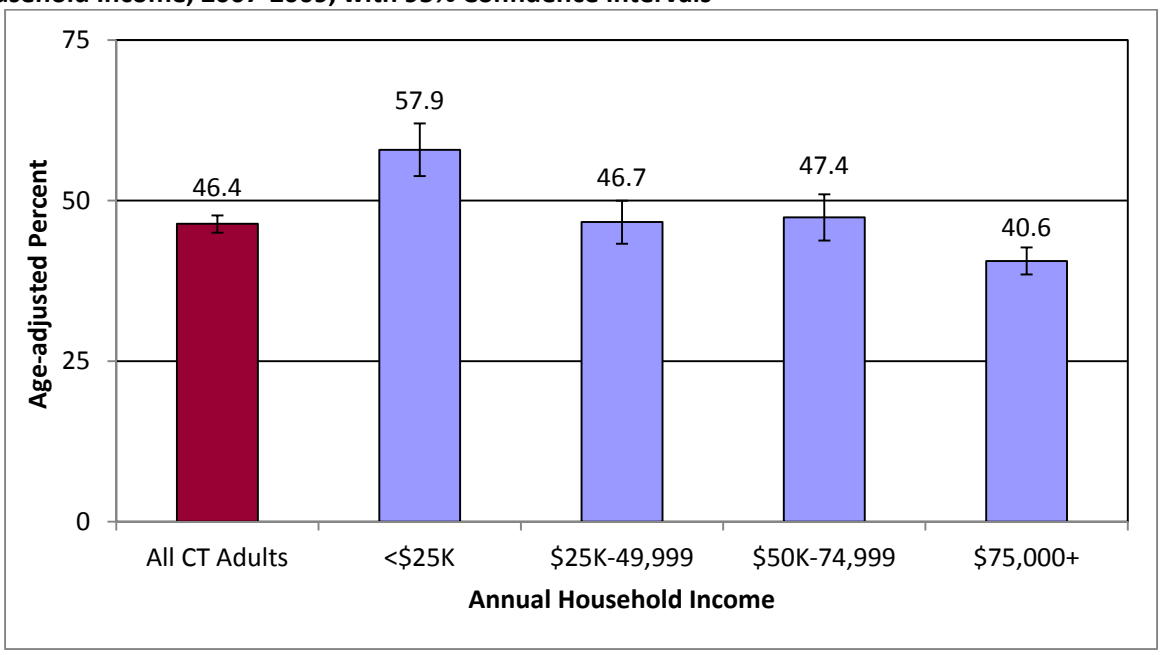
Physical Inactivity

Physical inactivity is associated with an increased risk of a number of chronic health conditions including CHD, diabetes, some cancers, HBP, obesity, and osteoporosis. Studies have shown that physical activity has protective effects on strokes.[1, 23]

The American College of Sports Medicine (ACSM), the American Heart Association (AHA), and the CDC recommend that healthy adults aged 18-65 years participate in moderate-intensity aerobic physical activity for a minimum of 30 minutes on five days per week or vigorous-intensity aerobic physical activity for a minimum of 20 minutes on three days per week.[24, 25] The guidelines are the same for adults aged 65 years and older; however, if older adults are unable to meet these guidelines because of chronic conditions, it is recommended that they participate in as much physical activity as possible.[25]

"Physical inactivity" is defined here as not meeting the recommendations of the ACSM, AHA, and CDC as described above. Approximately 47% of Connecticut adults report participating in less than the recommended amount of physical activity (2007-2009 data) compared with 49% nationwide (2009 data) (Figure 16).[14, 15] Rates of physical inactivity are higher among older adults, women, racial or ethnic minorities, and people with low incomes.[23] Physical inactivity increases with age. About 56% of adults 65 years old and older are physically inactive compared with about 48% of adults aged 45 to 64 years , and 43% of adults aged 18 to 44 years ($p<0.001$ for both comparisons) [data not shown]. Similarly, the physical inactivity rate among adults aged 45 to 64 years is significantly higher than that of adults aged 18 to 44 years ($p<0.005$) [data not shown].[14] Likewise, females are more likely to be physically inactive than males. An estimated 48.5% of adult females are physically inactive compared with 44% of adult males ($p<0.05$) [data not shown].[14] Additionally, Black and Hispanic adults are significantly more likely to report higher rates of physical inactivity than White adults ($p<0.001$ for Black and White comparison; $p<0.005$ for Hispanic and White comparison). The rates of physical inactivity among Black and Hispanic adults do not differ significantly. Approximately 44.5% of White, 59.7% of Black, and 54.2% of Hispanic adults report that they are physically inactive (data not shown).[14] Furthermore, adults with lower incomes are more likely to be physically inactive compared to adults with higher incomes. For example, about 58% of adults with annual household incomes of less than $25,000 are physically inactive compared to 41% of adults with annual household incomes of $75,000 or more ($p<0.001$) [Figure 26].[14]

Figure 26. Age-adjusted Prevalence of Physical Inactivity among Connecticut Adults by Annual Household Income, 2007-2009, with 95% Confidence Intervals



Source: Connecticut Department of Public Health, BRFSS, 2010.

Co-Prevalence of Cardiovascular Risk Factors

The co-prevalence of risk factors places an individual at elevated risk of CHD and stroke.[26] Approximately 42% of Connecticut adults report having two or more and 19% report having three or more modifiable risk factors for CVD.[14] The co-prevalence of risk factors contributes to the complexity of disease management.

RECOGNIZING THE SIGNS AND SYMPTOMS OF HEART ATTACK AND STROKE

The *Healthy People 2010* national objectives for both heart disease and stroke include increasing the proportion of persons who are aware of the early warning signs and symptoms of heart attack and stroke and the necessity of calling 911 when persons are suffering from either of these conditions (Table 6).[8] Early recognition of heart attack and stroke and calling 911 increase the likelihood of immediate emergency transport to the hospital and timely medical care that can reduce disability and death.

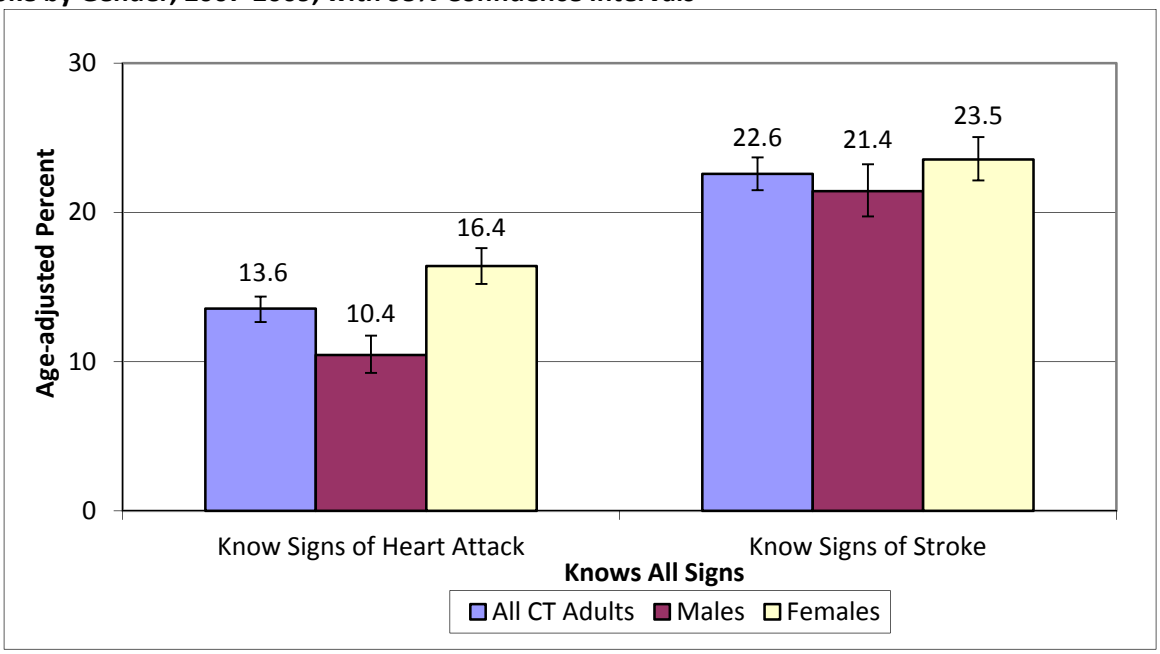
Table 6. Warning Signs for Heart Attack and Stroke

Heart Attack	Stroke
• Jaw, neck, back pain • Lightheaded, faint • Shortness of breath • Arm or shoulder discomfort • Chest pain or discomfort	• Severe headache with no known cause • Trouble seeing in one or both eyes • Confusion, trouble speaking • Trouble walking, dizziness, or loss of balance • Sudden numbness/weakness of face, arm, or leg

Source: American Heart Association, 2010.

The percentage of Connecticut adults who know all the warning signs and symptoms for heart attack and stroke tends to be very low. Only 13.6% of adults can identify all the proper heart attack signs and only 22.6% can identify all the proper stroke signs (2007-2009 data).[14] Women tend to be more knowledgeable than men about the signs and symptoms of heart attack and stroke. An estimated 16.4% of females know all heart attack signs compared with about 10.4% of males ($p<0.001$).[14] Also, approximately 23.5% of females know all signs of stroke compared with about 21.4% of males; however, this difference is not statistically significant [Figure 27].[14] Most adults, 91.4%, know that they should call 911 if they thought that someone was having a heart attack or stroke [data not shown].[14]

Figure 27. Age-adjusted Percentage of Connecticut Adults Who Know All the Signs of Heart Attack and Stroke by Gender, 2007-2009, with 95% Confidence Intervals

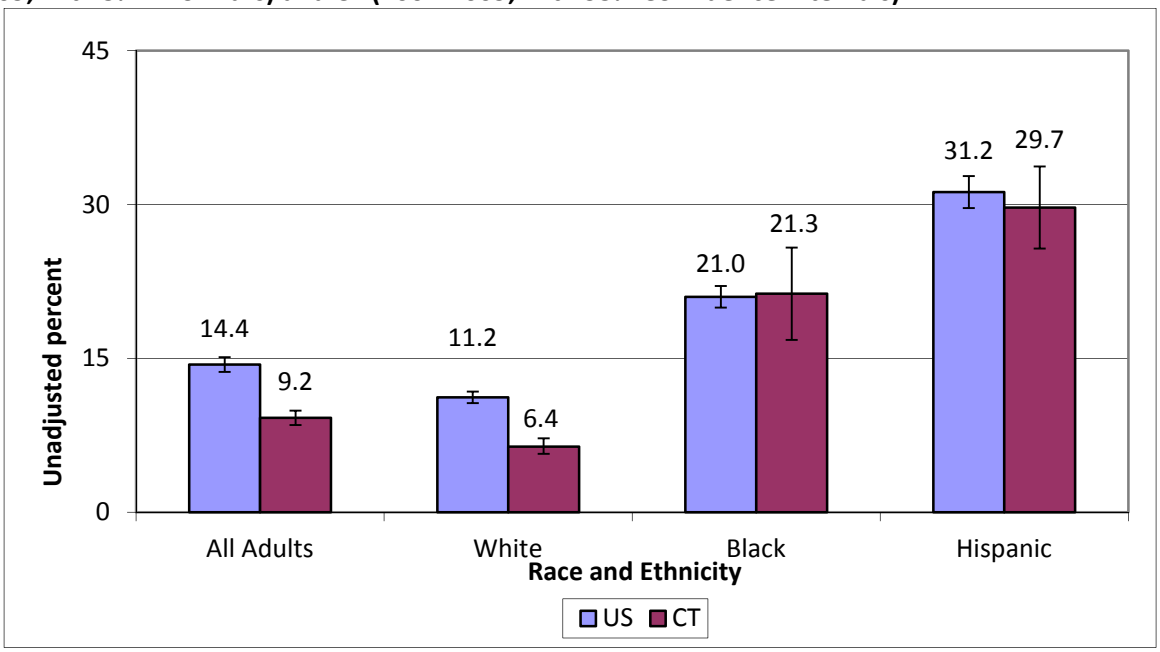


Source: Centers for Disease Control and Prevention, BRFSS, 2010.

ACCESS TO HEALTH CARE

Access to health care is crucial to the prevention, treatment, and management of heart disease and stroke. People without health insurance are less likely than those with health insurance to have a usual source of care, to receive preventive health care services, and to receive appropriate medical management of chronic conditions such as HBP, HBC, and diabetes.[27] About 9% of adults aged 18 and over do not have health insurance (2007-2009 data) compared with approximately 14% of adults nationwide (2009 data).[14, 15] Black and Hispanic Connecticut adults are significantly less likely to have health insurance than White Connecticut adults ($p<0.001$ for both comparisons). Approximately 6% of White, 21% of Black, and 30% of Hispanic adults do not have health insurance.[14] Comparable national figures show that about 11% of White, 21% of Black, and 31% of Hispanic adults report having no health insurance (Figure 28).[15]

Figure 28. Percentage of Adults Who Do Not Have Health Care Coverage by Race and Ethnicity, US (2009, with 5% Error Bars) and CT (2007-2009, with 95% Confidence Intervals)



Source: Centers for Disease Control and Prevention, BRFSS, 2010. Connecticut Department of Public Health, BRFSS, 2010.

TARGETING HIGH-RISK POPULATIONS

The high co-prevalence of modifiable risk factors for CVD indicates the need for public health interventions that focus on the prevention, early detection, and control of modifiable risk factors. The CDC recommends focusing efforts on increasing low dose aspirin therapy according to recognized guidelines; preventing and controlling HBC; reducing sodium intake; preventing and controlling HBC; and increasing the number of smokers counseled to quit and referred to quit lines as well as increasing the availability of no or low-cost cessations products.[28] The CDC also recommends addressing the priority areas through policies, systems, and environmental changes with the potential for broad reach and impact on the general population and high-risk populations.[28]

High-risk populations in Connecticut include Black, Hispanic, and lower-income residents. Black Connecticut residents have higher CVD and stroke mortality rates as well as higher CVD, CHD, and stroke premature mortality rates compared with White Connecticut residents. Black and Hispanic Connecticut residents have significantly higher rates of some important modifiable risk factors for CVD, such as HBC, diabetes, obesity, and physical inactivity compared with White Connecticut residents. Lower-income residents are also more likely to have higher rates of HBC, never having had cholesterol tested, diabetes, current smoking, obesity, and physical inactivity compared with higher-income residents.

Targeted, evidence-based public health interventions are warranted for all Connecticut residents with multiple risk factors. Special emphasis should be placed on interventions that address risk factor reduction among Black, Hispanic, and lower-income Connecticut residents. Evidence-based guidelines for disease prevention in the areas of diabetes, nutrition, physical activity, tobacco, and obesity are provided in the CDC's *Guide to Community Preventive Services*.[29] The 2011 Connecticut Chronic Disease planning process has focused its statewide health promotion and disease prevention efforts on policy, systems, and environmental changes at the state and local levels. Such policy, systems, and environmental changes have the potential to influence health-related behaviors in the general and high-risk populations.

APPENDICES AND REFERENCES

Appendix 1. Data Sources

Connecticut Vital Records Mortality Files

The Connecticut Vital Records Mortality Files are part of the state's vital statistics data base that contains records pertaining to deaths that occur within the state as well as deaths of Connecticut residents occurring in other states, or in Canada. Mortality statistics are compiled in accordance with the World Health Organization (WHO) regulations, which specify that deaths be classified by the current Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death. Deaths for the 1989-1998 period included in this report are classified by the Ninth Revision of the International Classification of Diseases [ICD-9].[30] Deaths for the 1999-2008 period are classified by the Tenth Revision of the International Classification of Diseases [ICD-10].[31]

The race-ethnicity designation is typically based on report by next of kin, a funeral director, coroner, or other official, often based on observations. As such, the race-ethnicity designation based on observation may be reported incorrectly. Another potential source of error is the fact that death rates are calculated using two different sources of data – the death certificate for the numerator and the U.S. Census Bureau population estimates for the denominator. Errors in under- or over-counting populations by race and/or ethnicity will affect the death rates reported for these groups. Mortality data are reported using racial categories that exclude persons of Hispanic origin (White, non-Hispanic and Black, non-Hispanic) and by Hispanic ethnicity (Hispanics of any race). Death Registry data follow the National Center for Health Statistics guidelines for coding race and Hispanic ethnicity.[5]

Connecticut Hospital Discharge Abstract and Billing Data Base

The Connecticut Hospital Discharge Abstract and Billing Data Base is the source of inpatient hospitalization data. It is maintained by the Connecticut Office of Health Care Access, and it contains patient-level demographic, clinical, and billing data for all non-federal acute care hospitals in the state. In addition to age, gender, and town of residence, the demographic data elements include race and ethnicity. Race and ethnicity may be based upon observation of the patient or self-reporting by the patient. Race is designated as White, non-Hispanic and Black, non-Hispanic; Hispanic ethnicity includes persons of any race.

It should be noted that counts reflect hospitalizations not persons. For example, a patient admitted to a hospital on two separate occasions in 2008 would be counted twice in these data. Another limitation of the data is the fact that it is an administrative data set. It contains diagnoses and procedures based on the International Classification of Diseases, Clinical Modification (ICD-9-CM) codes. The literature contains many reports on the reliability and validity of hospital discharge data with clinical conditions emphasizing discrepancies between ICD-9-CM codes and clinical data.[32]

Behavioral Risk Factor Surveillance System

The Behavioral Risk Factor Surveillance System (BRFSS) survey is a state-based system of health surveys that generate information about health risk behaviors, clinical preventive practices, and health care access and use. The BRFSS, sponsored by the Centers for Disease Control and Prevention, is the world's largest telephone survey, and is conducted in all 50 states. It is an on-going random sample telephone survey of non-institutionalized adults, 18 years and older. Information from the survey is used to improve the health of people nationwide and in Connecticut. Racial and ethnic classifications are based on self-report and include White, non-Hispanic, Black, non-Hispanic, and Hispanic (including persons of any race). Other national and state-specific risk factor data and information regarding BRFSS methodology can be accessed on the CDC's BRFSS Web site at: http://www.cdc.gov/brfss/.

Connecticut School Health Survey

The Connecticut School Health Survey (CSHS) is a comprehensive survey that consists of two components: Youth Tobacco Component (YTC) and the Youth Behavior Component (YBC). The CSHS is conducted by the Connecticut Department of Public Health in cooperation with the CDC, the Connecticut State Department of Education, and partners from local school health districts and local health departments. The YTC is a comprehensive survey of tobacco use, access, cessation, knowledge and attitudes, and exposure among Connecticut students in grades 6-12. The YBC collects data that is used to monitor priority health-risk behaviors and the prevalence of obesity and asthma among high school students in Connecticut. The YBC is administered to a representative sample of all regular public high school students in Connecticut. Racial and ethnic classifications are based on self-report and include White, non-Hispanic; Black, non-Hispanic; and Hispanic (including persons of any race). Further information about the CSHS can be found on the Connecticut Department of Public Health's web site: http://www.ct.gov/dph/cshs. Other national and state-specific youth risk factor data and information can be accessed on the CDC's web site: http://www.cdc.gov/HealthyYouth/YRBS/.

Appendix 2A. ICD-10 Coding for Selected Causes of Death, 1999-2008

Cause of Death	ICD-10 Code
All Causes	A00.0 – Y89.9
All Cancers	C00 – C97
Diabetes Mellitus	E10 – E14
Alzheimer's Disease	G30
Cardiovascular Disease	I00-I78
Diseases of the Heart	I00 – I09, I11, I13, I20 – I51
Coronary Heart Disease	I11, I20-I25
Congestive Heart Failure	I50.0
Essential Hypertension & Hypertensive Renal Disease	I10, I12
Cerebrovascular Disease	I60 – I69
Atherosclerosis	I71
Pneumonia and Influenza	J10 – J18
Chronic Lower Respiratory Diseases	J40 – J47
Unintentional Injuries	V01 – X59, Y85 – Y86

Source: World Health Organization. 1992. Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, based on the recommendations of the Tenth Revision Conference, 1992 (ICD-10). World Health Organization, Geneva.

Appendix 2B. ICD-9 Coding for Selected Causes of Death, 1989-1998

Cause of Death	ICD-9 Code
All Causes	1-E999
Cardiovascular Disease Deaths	390-459
Diseases of the Heart	390-398,402,404-429
Coronary Heart Disease	402, 410-414, 429.2
Congestive Heart Failure	428.0
Hypertension without Renal Disease	401, 403
Cerebrovascular Disease	430-438
Atherosclerosis	440

Source: World Health Organization. 1977. Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, based on the recommendations of the Ninth Revision Conference, 1975 (ICD-9). World Health Organization, Geneva.

Appendix 2C. ICD-9-CM Coding for Selected Causes of Hospitalizations

Cause of Hospitalization	ICD-9-CM Code
Circulatory	390-459
Coronary Heart Disease	402, 410-414, 429.2
Congestive Heart Failure	428
Cerebrovascular Disease	430-438

Source: Practice Management Information Corporation (PMIC). 2004. The International Classification of Diseases, Ninth Revision, Clinical Modification. 6th ed. PMIC, Los Angeles, CA.

Appendix 3A. Glossary of Statistical Terms

Age-adjustment. "Age adjustment, using the direct method, is the application of observed age-specific rates to a standard age distribution to eliminate differences in crude rates in populations of interest that result from differences in the populations' age distributions. This adjustment is usually done when comparing two or more populations at one point in time or one population at two or more points in time. Age adjustment is particularly relevant when populations being compared have different age structures, for example, the U.S. white and Hispanic populations…."[33]

Age-adjusted BRFSS rates. Some of the Behavioral Risk Factor Surveillance System (BRFSS) rate estimates presented in this report were age-adjusted, using the direct method, in order to eliminate differences in crude rates in populations of interest that result from differences in the populations' age distributions, such as those of Hispanics and Whites. The following age distributions and age-adjustment weights, based on the 2000 projected U.S. population, were used[34]:

Age Distributions and Age-adjustment Weights, 2000 Projected U.S. Population

Age	Population in thousands	Adjustment weight
18 years and over	203,851	1.000000
18 – 24 years	26,258	0.128810
25 – 44 years	81,892	0.401725
45 – 64 years	60,991	0.299194
65 years and over	34,710	0.170271

Age-adjusted Mortality Rates (AAMR) and Age-adjusted Hospitalization Rates (AAHR) are used to compare relative mortality and hospitalization risk, respectively, across groups and over time. They are not actual measures of risk but rather an index of risk. They are weighted statistical averages of the age-specific rates, in which the weights represent the fixed population proportions by age.[35] The AAMR and AAHR were computed by the direct method. The 1940 and 2000 U.S. standard million population distributions are shown below:

Age group	1940	2000
0-4	80,057	69,136
5-9	81,151	72,533
10-14	89,209	73,032
15-19	93,665	72,169
20-24	88,002	66,477
25-29	84,280	64,529
30-34	77,787	71,044
35-39	72,501	80,762
40-44	66,744	81,851
45-49	62,696	72,118
50-54	55,116	62,716
55-59	44,559	48,454
60-64	36,129	38,793
65-69	28,519	34,264
70-74	19,519	31,773
75-79	11,423	26,999
80-84	5,878	17,842
85+	2,765	15,508
Total	1,000,000	1,000,000

Cause-of-death classification. Mortality statistics for this report were compiled in accordance with the World Health Organization (WHO) regulations, which specify that member nations classify causes of death by the current Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death. Deaths for the 1989-1998 period were classified by the Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, Ninth Revision of the International Classification of Diseases (ICD-9).[30] Deaths for the 1999-2008 period were classified according to the Tenth Revision of the International Classification of Diseases (ICD-10).[31]

Healthy People 2010 is part of a national strategy addressing the prevention of major chronic illnesses, injuries, and infectious diseases. It is the product of an effort, involving expert working groups, a consortium of national organizations, all state health departments, and the Institute of Medicine of the National Academy of Sciences to set health objectives for the nation. After extensive national and regional hearings were conducted with a period of public review and comment, the health objectives were published in 1990 as *Healthy People 2000—National Health Promotion and Disease Prevention Objectives.* It established national objectives and served as the basis for the development of state and community plans. *Healthy People 2010* provides a comprehensive view of the nation's health in 2000, and establishes national goals and targets to be achieved by 2010, and monitors progress over time.[36]

Hispanic origin refers to people whose origins are from Spain, the Spanish-speaking countries of Central America, South America, and the Caribbean, or persons of Hispanic origin identifying themselves as Spanish, Spanish-American, Hispanic, Hispano, or Latino. Since 1988, the Connecticut death certificate has had a separate line item for Hispanic ethnicity. Individuals identified as "Hispanic" can be of any race, and are also counted in the race breakdown as either "white," "black," "Asian or Pacific Islander," "American Indian," or other.[5]

International Classification of Diseases 9th and 10th Revisions(ICD-9, ICD-10) have been the internationally accepted coding system for determining cause of death since the early 1900s. It is periodically revised. The Ninth Revision (ICD-9) was in use from 1975 through 1998. Beginning with 1999 deaths, the Tenth Revision (ICD-10) is being used.

Preliminary estimates of the comparability of ICD-9 to ICD-10 have been published and indicate that the discontinuity in trends from 1998 to 1999 for some leading causes of death (septicemia, influenza and pneumonia, Alzheimer's disease, nephritis, nephrotic syndrome, and nephrosis) is substantial.[37]

International Classification of Diseases, Clinical Modification (ICD-9-CM) is a coding system recommended for use in all clinical settings to describe medical procedures and diagnoses. It is required for reporting diagnoses and diseases to all U.S. Public Health Service and Department of Health and Human Services programs, including Medicare and Medicaid. The foundation of the ICD-9-CM is the *International Classification of Diseases, 9th Revision* published by the World Health Organization.[30]

Population bases for computing rates are taken from the U.S. Census Bureau's *Estimates of the population of states by age, sex, race, and Hispanic origin*. These data are estimates of the population of Connecticut by 5-year age groups (age 0 to 4, 5 to 9,…85 and over), sex (male, female), modified race (white; black; Native American including Alaska Natives; Asian and Pacific Islander) and Hispanic origin (Hispanic, non-Hispanic) for each year, July 1, 1999 through July 1, 2009.[5]

Premature mortality. See Years of Potential Life Lost.

Race refers to a population of individuals identified from a common history, nationality, or geographical place. Race is widely considered a valid scientific category, but not a valid biological or genetic category.[38, 39] Available scientific evidence indicates that racial and ethnic classifications do not capture biological distinctiveness, and that there is more genetic variation within racial groups than there is between racial groups.[40, 41] Contemporary race divisions result from historical events and circumstances and reflect current social realities. Thus, racial categories may be viewed more accurately as proxies for social and economic conditions that put individuals at higher risk for certain disease conditions.[32]

Data in this report include two racial groups in Connecticut: white, non-Hispanic and black, non-Hispanic. Individuals identified as "Hispanic" can be of any race.

Socioeconomic position refers to a person's social and economic place in a society, and is operationalized or measured by characteristics such as per capita or household income, educational attainment, or occupation. Historically, lower socioeconomic position has been strongly correlated with less favorable health outcomes such as premature mortality and higher death rates from all causes; conversely, persons of higher socioeconomic position do better on most measures of health status.[12]

Years of potential life lost (YPLL) represents the number of years of potential life lost by each death before a predetermined end point (e.g., 65 or 75 years of age). Whereas the crude and adjusted death rates are heavily influenced by the large number of deaths among the elderly, the YPLL measure provides a picture of premature mortality by weighting deaths that occur at younger ages more heavily than those occurring at older ages, thereby emphasizing different causes of death. Age-adjusted YPLLs are calculated using the methodology of Romeder and McWhinnie.[42] This method consists of a summation of the number of deaths occurring at each age (betweem 1 and 75) multiplied by the remaining years of life had the deceased lived up to age 75.

Appendix 3B. Glossary of Medical Terms

Atherosclerosis: A disease that affects the arteries, particularly those supplying the heart, the brain, the aorta, and the lower extremities. Atherosclerosis underlies the occurrence of heart attacks, many strokes, peripheral arterial disease, and ruptures of the aorta.[43]

Cardiovascular Diseases (CVD): Diseases of the circulatory system, which include acute myocardial infarction, ischemic heart disease, valvular heart disease, peripheral vascular disease, arrhythmias, high blood pressure and stroke.[44]

Coronary Heart Disease (CHD): A form of heart disease resulting from impaired circulation in one or more coronary arteries. Common clinical manifestations of CHD include chest pain (angina pectoris) or "heart attack".[44]

Cerebrovascular Disease: A disease of one or more blood vessels in the brain, which often results in the sudden development of a focal neurologic deficit, or stroke. Stroke, or a "brain attack" is the most severe clinical manifestation of cerebrovascular disease.[1, 45]

Congestive Heart Failure: The inability of the heart to maintain adequate pumping function, which can be caused by a number of factors, such as untreated hypertension, heart attacks, or infections. Heart failure increases the risk for other cardiovascular disease events and often results in physical disability. Congestive Heart Failure is commonly referred to as "heart failure".[43-45]

Diabetes (or diabetes mellitus): A metabolic disorder that results from the body's insufficient production or utilization of insulin. The most common types of diabetes includes "Type 1 diabetes," formerly known as "juvenile diabetes," and "Type 2 diabetes," formerly known as "adult-onset diabetes." Long-term effects of diabetes include cardiovascular complications.[43]

Dyslipidemia: A disorder of lipoprotein metabolism, such as an overproduction or deficiency of lipoprotein. Dyslipidemia is often manifested by elevated levels of total cholesterol, the "bad" or low-density lipoprotein (LDL) cholesterol, and the triglyceride concentrations, as well as decreased levels of the "good" or high-density lipoprotein (HDL) cholesterol concentration in the blood.[46]

Essential Hypertension: high blood pressure without a secondary cause such as renal failure. Approximately 95% of all cases of hypertension are classified as essential hypertension.[47]

Heart Failure: See Congestive Heart Failure.

Hemorrhagic Stroke: Hemorrhagic stroke occurs when a weakened blood vessels ruptures causing bleeding within the brain. The resulting accumulation of blood compresses nearby brain tissue. Hemorrhagic stroke is often associated with high blood pressure. About 13% of all strokes are hemorrhagic.[48]

High Blood Cholesterol: Cholesterol is a substance found in all cells of the body; it is carried in lipoproteins, made of fat (lipid) on the inside and proteins on the outside. Low-density lipoprotein (LDL) cholesterol is sometimes called "bad cholesterol" because it leads to a buildup of cholesterol in arteries. The chance of heart disease increases with increasing LDL levels in the blood. The buildup of cholesterol in the arteries is called plaque, which over time causes the narrowing of the arteries, or "atherosclerosis." Some plaques can burst, releasing fat and cholesterol into the bloodstream, which may cause the blood to clot and block the flow of blood. This blockage can cause angina or a heart attack. Lowering one's cholesterol level decreases the chance of having a plaque burst and a subsequent heart attack. Lowering cholesterol may also slow down, reduce, or even stop plaque from building up.[49]

High Blood Pressure: A condition in which the pressure in the arterial circulation system is greater than clinically recommended, that is a systolic pressure greater than or equal to 140 mm Hg or a diastolic pressure greater than or equal to 90 mm Hg. High blood pressure is associated with increased risk for heart disease, stroke, and chronic kidney disease.[43]

Hypertensive Heart Disease: An abnormality in the structure and function of the heart caused by long-standing high blood pressure. A common, clinical manifestation of hypertensive heart disease is heart failure.[43]

Ischemic Heart Disease: A condition in which heart muscle is damaged or works inefficiently because of an absence or deficiency of its blood supply. Ischemic heart disease is most often caused by atherosclerosis, and includes angina pectoris, acute myocardial infarction, chronic ischemic heart disease, and sudden death.[44]

Ischemic Stroke: The most common type of stroke that results from an obstruction within a blood vessel supplying blood to the brain. Atherosclerosis is the cause of the obstruction. About 87% of strokes are ischemic strokes.[50]

Obesity: Defined in terms of body mass index (BMI), and calculated as body weight in kilograms (1 kg = 2.2 lbs.) divided by height in meters (1 m = 39.37 in) squared. Adults with a BMI of greater than or equal to 30.0 kg/m2 are considered "obese," and those with a BMI of 25–29.9 kg/m2 are considered "overweight".[43]

Classification of Overweight and Obesity in Adults According to BMI.[44] Obesity is classified as BMI $\geq$ 30 kg/m^2.		
Classification	**BMI (kg/m^2)**	**Risk of Health Problems**
Underweight	< 18.5	Low (but risk of other clinical problems increased)
Normal range	18.5-24.9	Average
Overweight	25.0-29.9	Mildly increased
Obese	**> 30.0**	
Class I	30.0-34.9	Moderate
Class II	35.0-39.9	Severe
Class III	> 40.0	Very severe
Note that these values are age-independent and correspond to the same degree of fatness across different populations.		

Serum (Blood) Lipids: Cholesterol and triglycerides are types of lipids circulating in the blood. Over time, elevated cholesterol and triglycerides in the blood can become plaque in artery walls leading to atherosclerosis. Elevated cholesterol and triglyceride levels are often found in individuals with other major risk factors for heart disease (obesity, diabetes, and/or high blood pressure).[51]

Stroke: The most common clinical manifestation of cerebrovascular disease. Stroke describes an interruption of the blood supply in the brain that results in damaged brain tissue. It can be caused by clots or by bleeding in the brain from a ruptured blood vessel or a significant injury.[1, 52]

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