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Cardiovascular Diseases in American Women

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Abstract

Aims—Cardiovascular disease (CVD) is one of the major public health issues in women among diverse populations across the world. This article reports current information about the occurrence and risk factors of atherosclerotic CVD in American women.

Data Synthesis—The most recent scientific publications from the American Heart Association, the Centers for Disease Control and Prevention, and the National Heart, Lung, and Blood Institute and elsewhere were reviewed in regard to CVD in the US population. We focused on the atherosclerotic CVD in women, which includes coronary heart disease, stroke, and heart failure. Prevalence, incidence, and mortality of these diseases in women were described. The statistics about CVD on women were compared to men's. Special physiological changes in women and their relationships to CVD were discussed. The major modifiable risk factors were discussed.

Conclusion—About 35% women in the United States have some form of CVD and for men, this number is 37.6%. The CVD incidence for women was close to that of men 10 years younger. The gap narrows with advancing age. Since 1984, the number of CVD deaths for women has exceeded those for men. Women represent 52.6% of CVD deaths, and CVD is the leading cause of death in US women. In both men and women risk factors such as hypertension, high blood cholesterol level, smoking, lack of physical activity, and obesity increase the probability of developing CVD. Menopause, oral contraceptive use, and bilateral oophorectomy in premenopausal women also affect the risk of CVD in women.

About 1 in 3 women (34.9%) in the United States has some form of cardiovascular diseases (CVD). For men, the number is 37.6%[1]. About 1 in 2.7 women will eventually die of CVD compared to 1 in 4.6 women died of cancer[1]. CVD is a major public health issue in women. This article reports the recent information of the occurrence and risk factors of the atherosclerotic CVD in American women, which include coronary heart disease (CHD), stroke, heart failure, and related risk factors. We will present data for each of them separately after discussion for all CVD.

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Incidence

National Heart, Lung, and Blood Institute - sponsored Atherosclerosis Risk in Communities Cohort Study (ARIC) (1987–2001) indicated that the average annual rates of the first CVD events were 1.4, 3.3, 6.9, and 10.7 per 1000 women for age groups 45–54, 55–64, 65–74, and 75–84 respectively[2]. For men the corresponding numbers were 2.8, 5.4, 10.5, and 14.4. The rates for women were close to that of men 10 years younger.

Mortality

There is an overall reduction in the death rate due to CVD in the United States in the past several decades. But the decrease is less for women than men and less for African-American women than white women[3,4]. Since 1984, the number of CVD deaths for women has exceeded those for men (Figure 1). Women represent 52.6% deaths of CVD[1]. In the United States (2005), there were 454, 613 women died of cardiovascular diseases while 268, 890 women died of all forms of cancer. CVD as the underlying cause of death accounted for 36.7% of all deaths for women in 2005. The number for men is 34.2%. CVD death rates were 331.1/100,000 for men and 237.1/100,000 for women in 2005. CVD is the leading cause of death in women. This is true for women of different ethnic background including white, black, Hispanic or Latino, American Indian/Alaska Native, and Asian/pacific islander women[1]. Between 1980 and 2002, death rates due to heart disease among those 35 years of age fell by 52% in men and 49% in women. However, when broken down by age and decade (1980–1989, 1990–1999, and 2000–2002), among men 35 to 54 years of age, the average annual rate fell by 6.2%, 2.3%, and 0.5%, respectively. Among women 35 to 54 years of age, the average annual rate of death fell by 5.4% and 1.2% and then increased by 1.5%, respectively[5].

Risk factors

Cigarette smoking, hypertension, dyslipidemia, diabetes mellitus, obesity, sedentary lifestyle, and poor nutrition are important risk factors for CVD in women. There are disparities for risk factor by ethnicity. Black women had the highest obesity prevalence in women (47.3%). Black women also had the highest hypertension prevalence (51.2% for women without a high school education, and 37% for women with high school or higher education) among all women[6]. Some communities of American Indian women had an alarmingly high prevalence (54%) and incidence (22.2% in a 4 year period) of diabetes[7,8].

Coronary Heart Disease

Today, there are about 3.2 million women have a history of myocardial infarction (MI or heart attack)[1]. The first event of coronary heart disease (CHD) happens about 10 years later in women than men, especially after menopause[9]. Though women had marked advantage in age-specific risk of CHD, the greater life expectancy of women produces nearly equal numbers of actual deaths due to CHD in men and women[10].

Incidence

In the ARIC study, in participants 45 to 64 years of age, the average age-adjusted CHD incidence rates per 1000 person-years were as follows: white men, 12.5; black men, 10.6; white women, 4.0; and black women, 5.1[2]. The annual age-adjusted rates per 1000 population of first MI (1987–2001) in ARIC Surveillance were 4.2 in black men, 3.9 in white men, 2.8 in black women and 1.7 in white women. Among American Indians 45 to 74 years of age, the incidence (average annual rate per 1000 population) for nonfatal CHD is 6.1 for women and 12.2 for men[11].

Mortality

In 2005, the overall CHD death rate was 144.4 per 100,000 population. The death rates were 187.7 for white men and 213.9 for black men; for white women, the rate was 110, and for black women it was 140.9. Among American Indian, the average annual mortality per 1000 population for CHD is 3.3 for women and 8.0 for men[1]. Women are more likely than men (64 vs. 50 percent) to suffer sudden CHD death (SCD) without prior evidence of coronary heart disease.

Between 70% and 89% of sudden cardiac deaths occur in men, and the annual incidence is 3 to 4 times higher in men than in women. However, this disparity decreases with advancing age with a male-to-female ratio for SCD of 7:1 in 45- to 64-year-olds but only 2:1 in 65- to 74-year-olds[12]. Analysis of CHD mortality data among US adults 35 to 54 years of age showed that the annual percent change in (age-adjusted) mortality slowed markedly from 1980 to 2002 in both men and women. Particularly noteworthy is that the mortality rate among women 35 to 44 years of age had been increasing on average by 1.3% per year since 1997[5]. Two thirds of women who suffer a myocardial infarction never completely recover[13].

Risk factors

Besides the common CHD risk factors for both men and women such as: tobacco use, diabetes mellitus, hypertension, high lipid levels, obesity, and physical inactivity, some risk factors are unique in women. Persuasive evidence shows that bilateral oophorectomy in premenopausal women is related to the increased risk of coronary heart disease if exogenous hormones are not given[14]. But the influence of menstrual cycle and menopause on the risk of coronary heart disease still needs to be appropriately defined[15,16]. Reports from the Women's Health Initiative Study indicated that neither estrogen alone nor estrogen plus progestin decrease the risk of CHD in postmenopausal women[17,18]. The report from the Heart and Estrogen Progestin Replacement Study reported that hormonal therapy did not reduce the cardiovascular risk in postmenopausal women with established CHD[19].

Stroke

Stroke is a serious healthcare burden for United States. It is the third leading cause of death in our country just after heart disease and cancer. And it is the leading cause of serious,

long-term disability. Today, there are 2.7% of men and 2.5% of women 18 years of age had a history of stroke.

Incidence

There are approximately 55,000 more women than men who have a stroke each year. Data from ARIC study indicated that the age-adjusted stroke incidence rates in people 45 to 84 years of age are 6.6 per 1000 population in black men, 3.6 in white men, 4.9 in black women, and 2.3 in white women. At younger ages, men's stroke incidence is higher than women's but women's incidence increase more rapidly at older ages. Data from the Cardiovascular Health Study and ARIC indicated that men's stroke incidence is higher than women's before 80 years old. But after 80 years old, women's stroke incidence is higher than men's[2]. The male-to-female incidence ratio reaches 1.07 in those 75 to 84 years of age, and become 0.76 in those 85 years of age[1]. There is also ethnic difference in stroke incidence. The data from the Strong Heart Study indicated that in American Indians 45–74 years of age, the annual stroke incidence per 100,000 people is 653 for men and 707 for women [20]. It was reported that the stroke incidence for Hispanic population is lower than for blacks and higher than for whites[21]. More than 9000 men and women without prevalent stroke were followed for up to 50 years over 3 consecutive periods (1950–1977, 1978–1989, and 1990–2004) in the Framingham Heart Study. The data showed that in these three periods, the incidence of stroke was 7.6, 6.2, and 5.3 per 1000 person-years for men and 6.2, 5.8, and 5.1 for women. During this period of time, the lifetime risk of stroke at age 65 decreased from 19.5% to 14.5% in men and from 18.0% to 16.1% for women. Thirty-day mortality significantly decreased from 23% to 14% in men and the decrease was not significant in women (from 21% to 20%)[22].

Mortality

Because of women's longer life expectancy, there were more stroke deaths in women than in men each year. It is reported that 60.6% US stroke deaths were in women in 2005[1]. In 2005, the overall stroke death rate per 100,000 resident population in the US was 46.6. The number for men was 46.9 and for women 45.6[23]. There is ethnicity difference for stroke death rates. The 2005 death rates were 44.8 per 100,000 resident population for white men and 44.4 for white women. For black men and women, the numbers were 70.5 and 60.7 respectively. For American Indian/Alaska Native men and women, the numbers were 31.3 and 37.1. For Asian/Pacific Islander men and women, the numbers were 41.5 and 36.3. For Hispanic/Latino men and women, the numbers were 38.0 and 33.5 respectively[23]. Death rates for American Indians/Alaska Natives and Asian/Pacific Islanders were known to be underestimated[23].

Stroke death rates declined from 1980 to 2005 in both men and women. But the decrease is greater in men than in women. The stroke death rate male-to-female ratio decreased from 1.11 in 1980 to 1.03 in 2005 [23].

The mean age of stroke death was 79.6 in 2002 as shown in death certificate data. Men had a younger mean age at stroke death (76.3) than females (81.6). Blacks (72.6), American Indians/Alaska Natives (71.4), and Asian/Pacific Islanders (75.4) had younger mean ages

than whites (80.7), and the mean age at stroke death was also younger among Hispanics (72.6) than non-Hispanics (79.9)[24].

Risk factors

High blood pressure, atherosclerosis, atrial fibrillation, tobacco use and diabetes are the most important risk factor for stroke. Besides these common risk factors for men and women, there are other factors which influence the incidence and mortality of stroke in women. Women at middle age (45–54) had a surge of stroke events according to the report of National Health and Nutrition Examination Survey 1999–2004 data[25]. Their stroke risk doubles the stroke risk for men at the same age. The authors concluded that this disparity may due to inadequate stroke risk factor management in women[25]. Oral contraceptive use is another unique stroke risk factor in women[26]. The results from Women's Health Initiative study, the Heart and Estrogen/Progestin Replacement Study, and the Women's Estrogen for Stroke Trial indicated that the use of estrogen alone or estrogen plus progestin increase the risk of stroke especially ischemic stroke in postmenopausal women[27–31]. A report from Women's Health Study indicated that consisting of abstinence from smoking, low body mass index, moderate alcohol consumption, regular exercise, and healthy diet was associated with a significantly reduced risk of total and ischemic stroke but not of hemorrhagic stroke[32]. Pregnancy is another unique stroke risk factor in women[33]. In the Baltimore-Washington Cooperative Young Stroke Study, The relative risk for cerebral infarction during pregnancy was 0.7, but it increased to 8.7 for the postpartum period. For intracerebral hemorrhage, the adjusted relative risk was 2.5 during pregnancy but 28.3 for the postpartum period[33].

Heart Failure

There are about 2.5 million women alive today have heart failure. For men and women, the number of hospital discharge for heart failure continued to increase from 877, 000 in 1979 to 1, 106, 000 in 2006. Women had higher number of hospital discharge than men each year during this period[1](figure 2). Another report from the hospitals in Worcester, Mass, indicated that women had higher heart failure incidence rate than men (250 and 194 respectively, per 100,000)[34]. It is reported that the increase of heart failure in US is related to the aging population[35]. It was shown that an increase proportion of women exist in heart failure patients and hypertension instead of coronary heart disease become the most common etiology[35,36]. The improved survival is also associated with the increase of heart failure in women but this effect was greater in men (5-year mortality hazard decreased 33%) than in women (decreased 24%)[37].

Incidence

According to the report from the Cardiovascular Health Study, among those who 65 years old, the age-adjusted annual Heart failure incidence rate per 1000 population were 27.21 for men and 17.89 for women. The number for black men and women were 23.46 and 20.77. The number for white men and women were 27.53 and 17.43[2]. However, the data from ARIC study indicated more obvious ethnic difference for heart failure incidence. Data from ARIC indicated that, among the people who were 45–84 years of age, the age-adjusted

annual heart failure incidence rate per 1000 population were 8.77 for men and 7.59 for women. The numbers for black men and women were 12.13 and 10.50. The number for white men and women were 7.67 and 6.32[2]. Another ARIC Study report indicated that the age-adjusted incidence rate (per 1000 person-years) for Caucasian women was 3.4 and it is significantly lower than all other groups (Caucasian men, 6.0; African-American women 8.1; African-American men 9.1). African-American women have a similar incidence as African-American men. Heart failure incidence in African-American women was higher than Caucasian men[38]. The high heart failure incidence in African-Americans can be largely explained by the high prevalence of atherosclerotic risk factors in African-American population.

The report from the Framingham Study indicated that the lifetime risk of developing HF for both men and women is 1 in 5 at 40 years of age. The lifetime risk of HF occurring without antecedent MI is 1 in 9 for men and 1 in 6 for women. This result indicated that the risk of CHF that is largely attributed by hypertension.

Mortality

The overall death rate for heart failure was 52.3 per 100,000 people. For white men and black men, the numbers are 62.1 and 81.9. For white women and black women, the numbers were 43.2 and 58.7 respectively. There were total 166,051 women died of heart failure in 2005 (56.8% of the deaths from heart failure)[1].

Risk factors

Among postmenopausal women with established coronary heart disease, diabetes was the strongest risk factor for heart failure especially when poorly controlled or with concomitant renal insufficiency or obese[39].

Risk factor

Age is an important non-modifiable risk factor for cardiovascular disease in both men and women. Though the prevalence in women was lower than in men before 40 years old, it increased rapidly later in a woman's life. By the fifth and sixth decade of life, prevalence in men and women equalized and in the following decades, women have higher prevalence than men[1].

Another non-modifiable risk factor for CVD is family history. In a small number of families, predisposition of coronary heart disease is monogenic, with transmission occurring in a mendelian pattern[40]. But most coronary heart disease is complex, reflecting contribution of multiple genes, with variations in several genes[9]. The association of gene variants with coronary disease is different between men and women indicated that different pathophysiology pathway may influence the manifestation of heart disease in men and women[41]. Differences in the sex hormones and their levels may also contribute to the different presentation of heart disease in men and women[42].

Hypertension

About 1 in 3 Americans has hypertension. This rate is similar in men and women. Before 45 years old, women have lower prevalence of hypertension than men. For age 45–54 years group, women and men have the same prevalence as 36.2%. For 55–64, 65–74, and over 75 years group, the prevalence of hypertension in women were 54.4, 70.8, and 80.2% respectively. The numbers in men were 50.2, 64.1, and 65% respectively[23]. Oral contraceptives may increase blood pressure in women and the risk of hypertension increases with duration of oral contraceptive use[43]. Among people who are 20 years and older, the prevalence of hypertension is the highest among black women (44.1%, age-adjusted) compared to all other races in both gender[23]. Unfortunately, the control rates of hypertension are lower in women than in men, especially in older women. The Framingham Study data indicated that for people <60, 60–79 and 80 years old, the control rates for men were 38%, 36%, and 38% respectively. But the numbers for women were 38%, 28%, and 23%[44]. The report from the Women's Health Initiative Observational Study showed the same trend[45].

High blood cholesterol level

It was reported that percent of population with high serum total cholesterol (≥ 240 mg/dl) were in a continuously declined trend in United States since 1960s. This decrease was shown in both men and women. During 2003 to 2006, among persons 20 years of age and over, 16.3% had serum cholesterol level ≥ 240 mg/dl. The number for men and women were 15.6% and 16.9% respectively. The average serum total cholesterol levels were also declined during this period. The observed mean serum total cholesterol levels for people ≥ 20 years of age were 200mg/dl during 2003 to 2006. The numbers for men and women were 199 and 201 mg/dl respectively[23]. National Health and Nutrition Examination Survey (NHANES) 1999 to 2002 data show that though women were more likely than men to have had their cholesterol checked during the preceding 5 years, those women whose test results indicated high cholesterol or who were on cholesterol-lowering medication were less likely than men to be aware of their cholesterol condition[24].

The average level of LDL cholesterol for American adults ≥ 20 years of age is 115.0 mg/dl. According to NHANES 2005–2006, among non-Hispanic whites, mean LDL cholesterol levels were 113.9 mg/dL for men and 116.0mg/dL for women. Among non-Hispanic blacks, mean LDL cholesterol levels were 115.1mg/dL for men and 109.7 for women. Among Mexican Americans, mean LDL cholesterol levels were 123.2 mg/dL for men and 110.3 mg/dL for women. The age adjusted prevalence of high LDL cholesterol in US adults was 26.6% in 1988–1994 and 25.3% in 1999–2004[46]. Also there were substantial increases in the awareness, treatment, and control of high LDL occurred during this time period. NHANES data of 1999–2004 showed that rates of LDL cholesterol control were lower among men than among women (22.6% versus 28.0%, respectively)[46].

The mean level of HDL cholesterol for American adults ≥ 20 years of age is 54.6mg/dL[1]. Women have higher HDL levels than men in all ethnic groups. NHANES 2005–2006 data indicated that among non-Hispanic whites, mean HDL cholesterol levels were 48.5mg/dL

for men and 60.3mg/dL for women. Among non-Hispanic blacks, mean HDL cholesterol levels were 52.1mg/dL for men and 62.1 mg/dL for women. Among Mexican Americans, mean HDL cholesterol levels were 47.0mg/dL for men and 55.5 mg/dL for women[1].

The mean level of triglycerides for American adults 18 years of age is 146.0/mg/dL. Among men, the mean triglyceride level is 157.7 mg/dL: 163.8 for white men; 121.0 mg/dL for black men; 165.2 mg/dL for Mexican American men. Among women, the mean triglyceride level is 135.0 mg/dL: 138.5 mg/dL for white women; 104.6 mg/dL for black women; 155.6 mg/dL for Mexican American women.

Adverse changes in lipid profiles accompany menopause, especially for LDL-cholesterol[9].

Smoking/Tobacco Use

In 2006, 21% of U.S. adults were current cigarette smokers, the same percentage as in the previous two years, suggesting that the decline in cigarette smoking prevalence is stalling. Men were more likely to be current cigarette smokers than women (24% compared with 18%)[23]. According to combined data from 2005–2006, among women 15 to 44 years of age, rates of past-month cigarette smoking were lower for pregnant (16.5%) women than for nonpregnant (29.5%) women; however, among those 15 to 17 years of age, the smoking rate for pregnant women was higher than for nonpregnant women (23.1% versus 17.1%)[1]. From 1997 to 2001 smoking during pregnancy caused 910 infant deaths annually[47].

Lack of physical activity and obesity

American adults have made little improvement toward achieving recommended levels of physical activity. Between 1995–1996 and 2005–2006, the percentage of adults 18 years of age and over engaged in regular leisure-time physical activity or strength training activities remained level. Among them, less women (29%) than men (33.1%) involve in regular leisure-time physical activity at year 2006[23]. Inactivity in 2005 was higher among women (12%) than men (8.4%). Women (66.3%) were more likely than men (56.0%) to report never engaging in vigorous physical activity. Of the 11.4% of adults who engaged in vigorous activity for 5 days/week, the proportion was higher among men (13.1%) than women (9.8%)[1].

Among adults 20–74 years of age, obesity rates have more than doubled since 1960–1962. From 1960–1962 to 2003–2006, the age-adjusted percentage of adults who were obese has increased from 13% to 34%. This trend is similar in men and women[23]. The long-term risk estimates for developing overweight and obesity were similar for both sexes varied modestly with age[48]. There are pronounced racial disparities for obesity prevalence in U.S. among women but not among men. Among black women; 41.5% of them were obese, compared with 19.3% of white women and 26.2% of Hispanic women[49].

Diabetes Mellitus

CVD risk in people with diabetes is so significant that diabetes is considered to be a CVD equivalent. Unique among common risk factors, diabetes dramatically closes the gap in

cardiovascular morbidity between men and women[50]. With the diagnoses of diabetes, the relative risk of CVD increases more in women than in men[51]. The prognostic impact of diabetes in a woman approximates that of having had an MI[50]. Most women with diabetes will develop CVD years earlier than their non-diabetic counterparts. There are 11.5 million, or 10.2% of all women aged 20 years or older have diabetes in the United States[52]. Men have a slightly higher prevalence (11.2%) than women. The situation is getting worse in both women and men[53–55]. The prevalence of diabetes mellitus increased by 8.5% from 2000 to 2001 among women. For men, the number is 4.6%. From 1990 to 2001, the prevalence of those diagnosed with diabetes mellitus increased 60% among women. For men, the number is 66%. Framingham Heart Study data indicated a doubling in the incidence of DM over the past 30 years. Among adults 40 to 55 years of age in each decade of the 1970s, 1980s, and 1990s, the age-adjusted 8 – year incidence rates of DM were 2.0%, 3.0%, and 3.7% among women[56]. Some groups of minority women such as black, Hispanic, and American Indian were hard-hit[57]. A report from NHANES 1971–2000 indicated that while the all-cause mortality and cardiovascular disease mortality rate decreased between 1971 to 1986 and 1988 to 2000 among diabetic men, neither all-cause nor cardiovascular disease mortality declined among diabetic women. And the all-cause mortality rate difference between diabetic and non-diabetic women more than doubled[58]. Although mortality due to heart disease has declined 27% in women without diabetes, it has increased 23% in women with diabetes[59].

Nutrition

To reduce cardiovascular disease risk, American Heart Association (AHA) recommends the following guideline: balance calorie intake and physical activity to achieve or maintain a healthy body weight; consume a diet rich in vegetables and fruits; choose whole-grain, high-fiber foods; consume fish, especially oily fish, at least twice a week; limit intake of saturated fat to <7% of energy, trans fat to <1% of energy, and cholesterol to <300mg per day by choosing lean meats and vegetable alternatives, selecting fat-free, 1%-fat, and low-fat dairy products, and minimizing intake of partially hydrogenated fats; minimize intake of beverages and foods with added sugars; choose and prepare foods with little or no salt; if consume alcohol, do it so in moderation; if eat food that is prepared outside of the home, follow the AHA Diet and Lifestyle recommendations[60]. The AHA recommends that all adults accumulate 30 minutes of physical activity most days of the week. At least 60 minutes of physical activity most days of the week is recommended for adults who are attempting to lose weight or maintain weight loss. The AHA also recommends that at least half of grain intake come from whole grains. As a set of goals, the AHA recommends intakes of <7% of energy as saturated fat, <1% of energy as trans fat, < 300 mg cholesterol, and 25%–35% of energy as total fat per day. It is recommended to consume 2.3g salt per day. Based on the adverse effect of alcohol and available epidemiological data, the AHA recommends that if alcoholic beverages are consumed, they should be limited to no more than 2 drinks per day for men and 1 drink per day for women, and ideally should be consumed with meals.

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Figure 1. CVD mortality trends for males and females (United States 1980–2005). Source: National Center of Health Statistics, Centers for Disease Control and Prevention.

Figure 2. Hospital discharges for congestive heart failure by sex (United States 1976–2006) Source: National Hospital Discharge Survey/National Center of Health Statistics, Centers for Disease Control and Prevention