Prevalence of nonfatal coronary heart disease among American adults

Earl S. Ford, MD, MPH, Wayne H. Giles, MD, MS, and Janet B. Croft, PhD *Atlanta, Ga*

Background Few national estimates of the prevalence of coronary heart disease in the United States are available.

Methods By using data from the Third National Health and Nutrition Examination Survey (1988 to 1994), we estimated prevalence of angina pectoris by questionnaire, self-reported myocardial infarction, and electrocardiographically (ECG)-defined myocardial infarction.

Results Among participants aged ≥40 years who attended the medical examination, the age-adjusted prevalence of angina pectoris, self-reported myocardial infarction, and ECG-defined myocardial infarction were 5.8% of 9255, 6.7% of 9250, and 3.0% of 8206 participants, respectively. Among participants aged ≥65 years compared with those aged 40 to 64 years, the prevalence of a self-reported myocardial infarction was more than 3 times higher and that of ECG-defined myocardial infarction more than 4 times higher. The prevalences of self-reported myocardial infarction and ECG-defined myocardial infarction, but not angina pectoris, were higher among men than women. Among women, prevalence of angina pectoris and self-reported myocardial infarction were highest among blacks; among men, these coronary heart diseases were somewhat higher among whites. Prevalence of ECG-defined myocardial infarction were similar for all 3 race or ethnicity groups in either sex. The age-adjusted prevalence of coronary heart disease defined by the presence of any of these conditions was 13.9% among men and 10.1% among women.

Conclusions Although the management of coronary heart disease has improved during the past 2 decades, it remains an important prevalent disease burden among adults. (Am Heart J 2000;139:371-7.)

Coronary heart disease remains the leading cause of death among the US population despite marked declines in mortality rates from coronary heart disease during this century.[1] Current vital statistics indicate that black men and women have higher age-adjusted mortality rates of coronary heart disease than white men and women, a reversal from earlier years.[1] Despite the high toll from this disease in the United States, few national data are available to provide current estimates of prevalence of persons who have survived this disease. Many studies have been conducted in select populations, and the generalizability of these findings is unknown. In addition, few such studies have included diverse populations in sufficient numbers to allow comparisons of various race or ethnic groups.

The Third National Health and Nutrition Examination Survey (NHANES III) collected data on a large sample of the US population from 1988 to 1994. This survey included several measures to define nonfatal coronary heart disease, including an angina questionnaire (based on the Rose questionnaire), self-reported history of myocardial infarction, and an electrocardiographic (ECG) examination. By using these sources of data, we calculated the prevalence of coronary heart disease in the United States and focused on age, sex, and race or ethnic differences in the prevalence of coronary heart disease.

Methods

Study design

From 1988 through 1994, NHANES III was conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention.[2,3] During a home visit, 20,050 participants aged 17 years and older were asked to complete a series of questionnaires administered by carefully trained interviewers. Participants were also asked to participate in a medical examination that included additional questionnaires, a medical examination, selected tests, and a phlebotomy. There were 17,705 participants aged ≥17 years who attended the medical examination. NHANES III used a multistage sampling design. To allow estimates for various population groups, the survey oversampled children aged 2 months to 5 years, persons aged 60 years and older, and blacks and Hispanics. Details about the survey and its methods have been published elsewhere.[2]

From the Division of Nutrition and Physical Activity and the Division of Adult Community Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention.
Submitted October 2, 1998; accepted March 15, 1999.
Reprint requests: Earl Ford, MD, MPH, Division of Nutrition and Physical Activity, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 4770 Buford Highway, Mailstop K26, Atlanta, GA 30341.
E-mail: esf2@cdc.gov
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Table I. Weighted crude and age-adjusted prevalence of angina pectoris, self-reported myocardial infarction, and ECG-detected myocardial infarction

	Angina (n = 9255)			History of MI (n = 9250)			ECG-defined MI (n = 8206)		
	n	Crude (%)	Age-adjusted (%)	n	Crude (%)	Age-adjusted (%)	n	Crude (%)	Age-adjusted (%)
Total	601	5.8 ± 0.4	5.8 ± 0.4	726	6.6 ± 0.4	6.7 ± 0.4	290	2.8 ± 0.3	3.0 ± 0.2
Age (y)									
40-64	300	4.9 ± 0.5	–	234	3.7 ± 0.3	–	88	1.4 ± 0.3	–
≥65	301	7.7 ± 0.4	–	492	12.7 ± 0.9	–	202	6.0 ± 0.5	–
Sex									
Men	256	5.2 ± 0.6	5.4 ± 0.6	457	8.8 ± 0.6	9.5 ± 0.6	189	3.7 ± 0.4	4.2 ± 0.4
Women	345	6.2 ± 0.5	6.2 ± 0.5	269	4.7 ± 0.4	4.5 ± 0.4	101	1.9 ± 0.4	2.0 ± 0.3
Whites									
Total	315	5.7 ± 0.4	5.6 ± 0.4	467	6.8 ± 0.5	6.8 ± 0.5	181	2.8 ± 0.3	3.0 ± 0.3
Men	156	5.4 ± 0.7	5.5 ± 0.6	303	9.2 ± 0.7	9.7 ± 0.7	119	3.8 ± 0.4	4.2 ± 0.5
Women	159	5.9 ± 0.5	5.7 ± 0.5	164	4.7 ± 0.5	4.3 ± .01	62	2.0 ± 0.4	1.9 ± 0.4
Blacks									
Total	160	6.6 ± 0.6	7.0 ± 0.7	148	5.8 ± 0.5	6.5 ± 0.6	63	2.6 ± 0.4	3.2 ± 0.4
Men	48	3.7 ± 0.6	4.0 ± 0.7	78	6.3 ± 0.7	7.4 ± 0.9	40	3.6 ± 0.6	4.5 ± 0.7
Women	112	8.8 ± 0.9	9.3 ± 0.9	70	5.4 ± 0.7	6.0 ± 0.7	23	1.8 ± 0.4	2.2 ± 0.5
Hispanics									
Total	126	5.8 ± 0.6	6.0 ± 0.5	111	4.1 ± 0.3	5.4 ± 0.7	46	1.9 ± 0.4	2.6 ± 0.5
Men	52	4.5 ± 0.5	5.0 ± 0.5	76	5.6 ± 0.8	7.3 ± 0.9	30	2.1 ± 0.5	3.1 ± 0.7
Women	74	7.0 ± 1.0	7.0 ± 0.9	35	2.7 ± 0.5	3.7 ± 0.7	16	1.7 ± 0.6	2.0 ± 0.7

Prevalence estimates were calculated with sampling weights; adjusted to 1980 US population with 5 age categories.
MI, Myocardial infarction.

Variables

During the home interview, participants completed an angina pectoris questionnaire similar to the London School of Hygiene and Tropical Medicine questionnaire (also known as the Rose questionnaire).[4] Participants were defined as having angina pectoris if they reported that they ever had any chest pain or discomfort, if they got the pain or discomfort while walking uphill or in a hurry, if the pain caused them to stop or slow down, if the pain was relieved by standing still, if the pain was relieved within 10 minutes, and if the pain was located in the upper or middle sternum, the left anterior chest, or the left arm. We classified participants who responded that they never walked uphill or in a hurry as having angina if they met the other criteria.

In addition, participants were asked "Has a doctor ever told you that you had a heart attack?" Participants who responded in the affirmative were classified as having a self-reported myocardial infarction.

Participants aged ≥40 years who attended the medical examination received a resting 12-lead electrocardiogram with a Marquette MAC 12 unit. Details about the ECG examination have been published previously.[3] Electrocardiograms were coded with Minnesota coding criteria at the University of Alberta.[5,6] Minnesota codes 1.1.1 through 1.1.7 and 1.2.1 through 1.2.7, together with codes 4.1, 4.2, 5.1, or 5.2, defined a probable myocardial infarction. Minnesota codes 1.2.1 through 1.2.7, without codes 4.1, 4.2, 5.1, or 5.2, and codes 1.2.8, 1.3.1 through 1.3.6, together with 4.1, 4.2, 5.1, or 5.2, defined a possible myocardial infarction.

Statistical methods

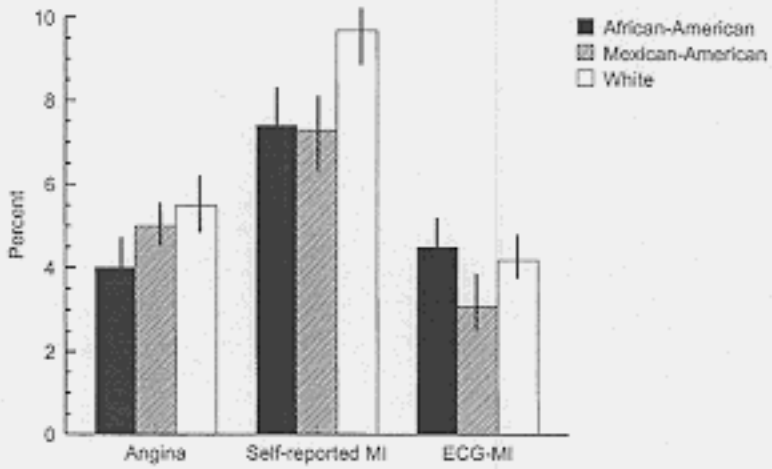
The covariates age, sex, and race or ethnicity (white, black, Hispanic) were self-reported during the home interview. Because of small numbers, we excluded participants with a race designation of "other" (n = 402) from the analysis. To avoid unstable estimates, we chose 2 broad age strata (40 to 64 years and ≥65 years). In calculating the prevalence of coronary heart disease as determined by a combination of 2 or 3 measures, we limited the denominators to participants with complete information for these measures. We standardized estimates of coronary heart disease prevalence to the 1980 US population aged ≥40 years. We used logistic regression analysis to calculate probability values for differences of coronary heart disease prevalence by age (40 to 64 years, ≥65 years), sex, and race or ethnicity. To estimate prevalence estimates, we used the medical examination clinic sampling weights. Sample weights were constructed that incorporate the differential probabilities of selection and were adjusted for undercoverage and nonresponse. All analyses were performed with the software SUDAAN (Research Triangle Institute, Research Triangle Park, NC), which takes into account the stratified multistage sampling design and produces valid estimates of the variance of the estimates.[7]

Results

Of 11,448 men and women aged ≥40 years who participated in NHANES III, 9737 attended the medical examination. The numbers of participants who provided information about angina or myocardial infarction and who received an ECG varied and are found in Table I.

Among the entire population aged ≥40 years, the age-adjusted prevalence of angina by questionnaire was 5.8%; of self-reported myocardial infarction, 6.7%; and of ECG-defined myocardial infarction, 3.0%. Compared with participants aged 40 to 64 years, participants aged

Figure 1



Age-adjusted prevalences (and 95% confidence intervals) of angina pectoris and myocardial infarction *(MI)* among men aged >40 years, by ethnic group: United States, NHANES III, 1988-1994.

Table II. Weighted crude and age-adjusted prevalence of coronary heart disease

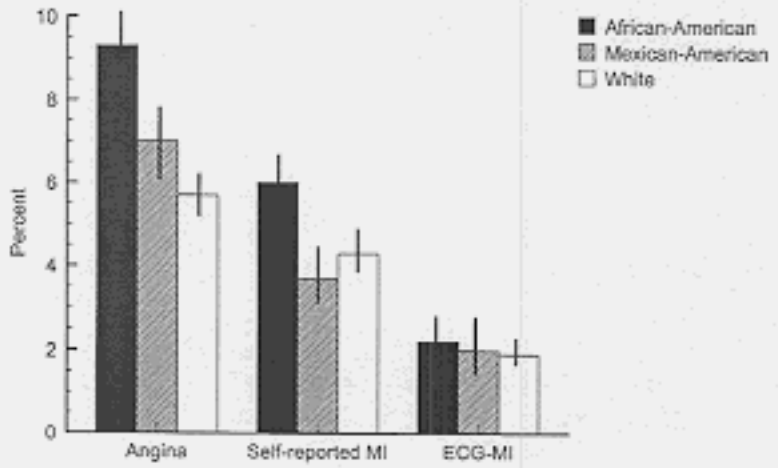
	Angina or history of MI			History of MI or ECG-defined MI			Angina, history of MI, or ECG-defined MI		
	n	Crude (%)	Age-adjusted (%)	n	Crude (%)	Age-adjusted (%)	n	Crude (%)	Age-adjusted (%)
Total	1125	10.6 ± 0.5	10.7 ± 0.5	746	7.6 ± 0.5	8.0 ± 0.4	1072	11.3 ± 0.6	11.8 ± 0.6
Age (y)									
40-64	475	7.7 ± 0.6	–	255	4.4 ± 0.4	–	462	8.2 ± 0.7	–
≥65	650	16.7 ± 0.8	–	491	14.9 ± 0.9	–	610	18.7 ± 0.9	–
Sex									
Men	596	11.7 ± 0.8	12.5 ± 0.7	473	9.9 ± 0.6	10.9 ± 0.6	591	12.8 ± 0.9	13.9 ± 0.9
Women	529	9.6 ± 0.7	9.3 ± 0.6	273	5.5 ± 0.6	5.6 ± 0.6	481	10.1 ± 0.8	10.1 ± 0.7
Whites									
Total	637	10.5 ± 0.6	10.5 ± 0.6	465	7.7 ± 0.5	8.0 ± 0.5	613	11.4 ± 0.7	11.7 ± 0.7
Men	371	12.1 ± 0.9	12.8 ± 0.9	299	10.2 ± 0.7	11.1 ± 0.6	361	13.2 ± 1.0	14.1 ± 1.0
Women	266	9.1 ± 0.7	8.7 ± 0.7	165	5.5 ± 0.6	5.4 ± 0.6	252	9.8 ± 0.8	9.6 ± 0.8
Blacks									
Total	276	11.3 ± 0.7	12.3 ± 0.8	151	6.9 ± 0.7	8.2 ± 0.7	243	11.5 ± 0.8	13.1 ± 0.9
Men	112	9.1 ± 0.8	10.2 ± 0.9	87	8.0 ± 1.0	9.7 ± 1.1	112	10.5 ± 1.0	12.4 ± 1.0
Women	164	13.1 ± 1.1	14.0 ± 1.1	64	6.1 ± 0.9	7.0 ± 0.9	131	12.3 ± 1.3	13.7 ± 1.3
Hispanics									
Total	212	9.1 ± 0.7	10.2 ± 0.9	130	5.6 ± 0.6	7.2 ± 0.8	216	10.2 ± 0.6	11.7 ± 0.8
Men	113	9.0 ± 0.8	10.8 ± 0.9	87	7.0 ± 1.0	9.3 ± 1.2	118	9.9 ± 0.9	12.3 ± 1.0
Women	99	9.2 ± 1.1	9.7 ± 1.1	43	4.2 ± 0.7	5.4 ± 0.8	98	10.5 ± 1.0	11.2 ± 1.1

Prevalence estimates were calculated with sampling weights; adjusted to 1980 US population with 5 age categories.
MI, Myocardial infarction.MI, Myocardial infarction.

≥65 years had a 57% higher prevalence of angina pectoris ($P < .001$), had a 3-fold higher prevalence of self-reported myocardial infarction ($P < .001$), and had more than 4-fold higher prevalence of ECG-defined myocardial infarction ($P < .001$).

Men had about twice the rate of self-reported myocardial infarction ($P < .001$) and ECG-defined myocardial infarction as women ($P < .001$) (Table I). ECG-defined myocardial infarction did not significantly differ between men and women among Hispanics. In contrast, the prevalence of angina was higher among women than men among all 3 race or ethnicity groups.

Figure 2



Age-adjusted prevalences (and 95% confidence intervals) of angina pectoris and myocardial infarction *(MI)* among women aged >40 years, by ethnic group: United States, NHANES III, 1988-1994.

The sex difference for angina was significant only among blacks ($P < .001$) and Hispanics ($P = .021$).

Although there was no overall difference in the prevalence of the 3 outcomes by race or ethnicity, interactions terms for sex and race or ethnicity were significant for angina ($P < .001$) and a self-reported history of myocardial infarction ($P < .004$). The prevalence of angina among men was similar for the 3 race or ethnicity groups, and the prevalence of self-reported myocardial infarction was highest among white men (Figure 1). Among women, the prevalence of angina ($P = .004$) and self-reported myocardial infarction ($P = .033$) differed among the 3 race or ethnicity groups; blacks had the highest prevalence of angina and self-reported myocardial infarction (Figure 2). The prevalence of ECG-defined myocardial infarction was similar among the 3 race or ethnic groups in both men and women.

We also calculated the prevalence of coronary heart disease with combinations of the 3 individual measures (Table II). By using any 1 of the 3 measures, 11.8% of the US population aged ≥40 years had coronary heart disease, and the prevalence of coronary heart disease was higher among men than women ($P = .003$). For all 3 definitions, white men had a significantly higher prevalence of coronary heart disease than white women. Among blacks, women had a higher prevalence of coronary heart disease (according to the definition of angina pectoris and self-reported myocardial infarction) than men ($P = .010$). Among Hispanics, the only significant sex difference was for the definition of coronary heart disease that included self-reported myocardial infarction and ECG-detected myocardial infarction ($P = .004$). There were no significant race differences. When stratified by sex, race differences among women ($P < .001$) but not men were present for prevalence of coronary heart disease that included angina pectoris as part of the definitions (Figure 3).

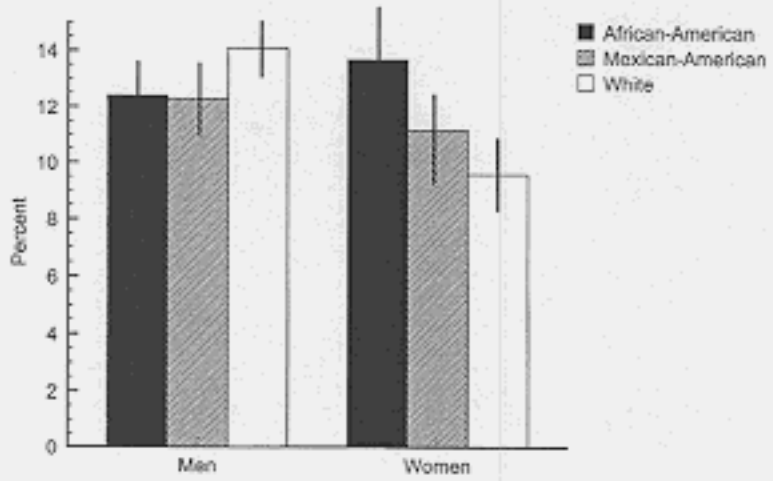
Discussion

Previously, the American Heart Association reported that 13,900,000 persons had coronary heart disease defined as either angina or self-reported myocardial infarction.[8] The prevalence for the US population aged ≥20 years was 7.2% (7.5% for whites, 6.9% for blacks, and 5.6% for Hispanics). These estimates were calculated with phase 1 data of NHANES III from 1988 to 1991. By using as a definition of coronary heart disease any of the 3 measures, we estimate that about 11.8% of the US population aged ≥40 years has coronary heart disease.

In many epidemiologic studies, researchers have used questionnaires (angina, self-reported myocardial infarction) and/or an ECG to define coronary heart disease.[9,24] Comparing these estimates is difficult because of differences in classification schemes for coronary heart disease, age distributions of the study samples, demographic compositions of the samples, and calender periods.

More recent reports of coronary heart disease prevalence in the United States include data from the Atherosclerosis Risk in Communities (ARIC) study, the Cardiovascular Health Study, and the Strong Heart Study. Among participants aged 45 to 64 years in the ARIC study, the prevalence of self-reported or physician-diagnosed myocardial infarction or Q-wave abnormalities was 7.3%, 5.6%, 1.7%, and 2.6% among white men, black men, white women, and black women, respectively.[20] In the Cardiovascular Health Study,

Figure 3



Age-adjusted prevalences (and 95% confidence intervals) of coronary heart disease among adults aged >40 years, by sex and ethnic group: United States, 1988-1994.

major Q- or QS-wave abnormalities occurred among 7.3% of mostly white men and 3.6% of women aged ≥65 years.[21] In the Strong Heart Study, men aged 45 to 74 years had higher rates of definite coronary heart disease than women, but women had higher rates of possible coronary heart disease than men.[18]

The large difference between self-reported myocardial infarction and ECG-defined myocardial infarction may be caused by overreporting, non-Q-wave myocardial infarctions, or perhaps timely interventions to relieve blockage of the coronary arteries. Unfortunately, NHANES III did not include questions about the use of thrombolytic therapy, coronary artery bypass surgery, or percutaneous transluminal coronary angioplasty.

The sex ratio of prevalence of angina pectoris by questionnaire in comparison with the sex ratio of ECG-defined myocardial infarction raises questions about the validity of the instrument among women, particularly among black women. Some authors have suggested that the Rose questionnaire or similar questionnaires perform less well among women than men[16,21,25-31]; in one study the sensitivity compared with exercise thallium testing was higher but the specificity was lower among women than men.[30] There may be differences in the way blacks respond to the Rose questionnaire.[32] However, some investigators believe that, despite potential shortcomings, the tool may be successfully used in black[33-36] and Hispanic populations.[34]

Two issues regarding this study deserve mention. First, only survivors of coronary heart disease were captured by this survey. Thus the prevalence of nonfatal disease does not reflect the burden of disease in the US population or that of the demographic groups included in this study. To better examine one measure of the burden of coronary heart disease in the US population, mortality rates from coronary heart disease would have to be incorporated. Second, the survey was conducted over a period of 6 years when temporal trends in the incidence of and death from coronary heart disease were occurring.[37] The larger decline in coronary heart disease mortality rate that was noted for whites than for blacks may have resulted in a somewhat higher number of coronary heart disease survivors among whites, thus increasing the prevalence of nonfatal coronary heart disease among whites to a greater extent than that among blacks.

In conclusion, approximately 11.8% of the US population aged ≥40 years reports either having angina pectoris or having had a previous myocardial infarction or has electrocardiographic criteria consistent with a previous myocardial infarction. Significant race differences in prevalence estimates were present among women but not men. For the entire population, significant sex differences in coronary heart disease prevalence were present for all measures except angina pectoris. However, considerable variation in these sex differences occurred among the 3 race or ethnic groups and was a function of the definition of coronary heart disease. Much of this variation can be attributed to the relatively high prevalence of angina pectoris among black and Hispanic women. These results demonstrate that coronary heart disease remains a considerable public health problem in the United States despite improvements in the prevention and therapeutic management of this condition.

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