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Trends in Predicted 10-Year Risk of Coronary Heart Disease and Cardiovascular Disease Among U.S. Adults From 1999 to 2010

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Abstract

Objectives—The objective of this study was to examine trends in predicted 10-year risk for coronary heart disease (CHD) and cardiovascular disease (CVD) from 1999 to 2000 and from 2009 to 2010 among adults in the United States.

Background—Examining trends in predicted risk for CHD and CVD may offer insights into the direction of cardiovascular health.

Methods—Data from 7,751 fasting participants, ages 30 to 74 years, of 6 consecutive 2-year cycles of the National Health and Nutrition Examination Survey were used. Predicted 10-year risk for CHD and CVD was calculated using risk equations derived from data from the Framingham Heart Study.

Results—Mean predicted 10-year risk for CHD was 7.2% during 1999 to 2000 and 6.5% during 2009 to 2010 (p for linear trend = 0.005), and for CVD it was 9.2% during 1999 to 2000 and 8.7% during 2009 to 2010 (p for linear trend = 0.152). Mean predicted risk for CHD and CVD declined significantly among participants ages 40 to 49 years, 50 to 59 years, 60 to 74 years, and among women. Mean predicted risk for CHD declined significantly among men and whites but nonsignificantly among Mexican Americans (p for linear trend = 0.067). Mean predicted risk increased nonsignificantly among African Americans for both CHD (p for linear trend = 0.063) and CVD (p for linear trend = 0.059). Of the modifiable cardiovascular risk factors included in the risk equations, favorable trends were noted for mean systolic and diastolic blood pressure, mean concentrations of total cholesterol and high-density lipoprotein cholesterol, and smoking status. The prevalence of diabetes mellitus worsened.

Conclusions—Predicted 10-year risk for CHD improved modestly. Reversing the seemingly rising trend in risk among African- American adults should be a high priority.

Keywords

cardiovascular diseases; coronary artery disease; risk; risk factors; trends

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Dr. Ford has reported that he has no relationships relevant to the contents of this paper to disclose.

National data about incident coronary heart disease (CHD) and cardiovascular disease (CVD) in the United States have proven historically difficult to collect, and consequently, alternative sources of information are needed to generate insights into this essential surveillance need. In recent years, several regional U.S. studies have shown decreases in incident CHD (1). Examining the trend in predicted risk for CHD and CVD represents a potential window into the future dynamics of incident CHD and CVD. Previous studies have examined changes in predicted 10-year risk of CHD using national data through 2004 (2,3). The objective of the current study is to examine recent trends in predicted risk for CHD and CVD among U.S. adults.

Methods

Data from 6 consecutive 2-year cycles of NHANES (National Health and Nutrition Examination Survey) from 1999 to 2000 and 2009 to 2010 were used (4). Using a multistage, stratified sampling design, NHANES selected national samples representative of the civilian, noninstitutionalized U.S. population. Trained interviewers administered study questionnaires to participants in their homes and extended an invitation to participants to have an examination at a mobile examination center where they were asked to undergo various examinations, provide a blood sample, and complete additional questionnaires. The response rates for all the surveys exceeded 70%. The National Center for Health Statistics Research Ethics Review Board granted approval for the surveys, and participants were asked to sign an informed consent form.

Predicted 10-year risk for CHD (angina pectoris, myocardial infarction, coronary insufficiency, and CHD death) and CVD (coronary death, myocardial infarction, coronary insufficiency, angina, ischemic stroke, hemorrhagic stroke, transient ischemic attack, intermittent claudication, and heart failure) was determined from risk algorithms derived from Framingham Heart Study data (5,6). These algorithms include age, concentrations of total cholesterol and high-density lipoprotein cholesterol (HDLC), blood pressure, treatment for hypertension, smoking status, and diabetes mellitus. Treatment for hypertension was based on self-reported current use of antihypertensive medication. Diabetes was defined as self-reported use of oral hypoglycemic medications or insulin or fasting plasma glucose ≥126 mg/dl.

The analyses were limited to fasting participants ages 30 to 74 years who attended the morning examination and had a complete set of data. Participants who reported having CVD (congestive heart failure, coronary heart disease, angina pectoris, myocardial infarction, and stroke) and pregnant women were excluded. Tests for linear trend were conducted with orthogonal linear contrasts. The SUDAAN statistical software package (RTI International, Durham, North Carolina) was used to analyze the data to account for the complex sampling design of the surveys. Sampling weights were used in the analyses.

Results

The analyses included 7,751 participants. Sociodemographic characteristics are show in Table 1. Mean levels of systolic blood pressure (SBP) and diastolic blood pressure (DBP), mean concentrations of total cholesterol, and the percentage of current smokers decreased during the study period, whereas mean concentrations of HDLC and the prevalence of diabetes increased (Table 1).

Compared to the 7,751 participants included in the analysis, relative differences in means and percentages of demographic variables and risk factors for the 6 consecutive 2-year cycles combined among participants age 30 to 74 years who did not attend the morning examination were 2.3% or less except for diabetes (6.6% higher), current use of antihypertensive medications (6.1% lower), and current smoking (4.5% higher). However, the 95% confidence intervals for the estimates overlapped to some degree except for SBP, DBP, and HDLC, which were all slightly worse among participants who did not attend the morning examination.

The mean predicted 10-year risk for CHD decreased significantly from 7.2% during 1999 to 2000 to 6.5% during 2009 to 2010 (Table 1). However, the mean risk for CVD showed no significant improvement. When stratified by age, the mean risk for CHD and CVD decreased significantly in the 3 oldest age groups. Mean risk for CHD decreased significantly among men and women, and mean risk for CVD decreased significantly among women. Mean risk for CHD decreased significantly among whites and decreased nonsignificantly among Mexican Americans. Mean risk for CHD and CVD increased nonsignificantly among African Americans (Fig. 1).

Discussion

The current analysis shows that predicted 10-year risk for CHD but not CVD improved modestly and significantly during the 10-year time period. The declining predicted risk for CHD in the presence of large increases in obesity and diabetes in the United States may be attributed in large measure to improvements in the prevalence of smoking, mean levels of SBP and DBP, and mean concentrations of total cholesterol and HDLC. In the absence of increasing prevalence of diabetes, predicted risk would have declined at a stronger pace.

The lack of significant improvements in mean SBP and concentrations of total cholesterol coupled to strong increases in prevalent diabetes among African Americans largely account for the racial differences (data not shown). Among whites, significant and larger improvements were noted for mean levels of SBP and DBP as well as mean concentrations of total cholesterol and HDLC. The change in diabetes from 6.4% to 10.3% among whites (p for linear trend = 0.115) proved less than the change from 7.9% to 14.1% among African Americans (p for linear trend = 0.008).

Changing the course of predicted risk for CHD and CVD among African-American adults will require both population and clinical approaches. Because blood pressure, lipids, and diabetes have powerful behavioral underpinnings, effective and efficient population-based approaches in promoting heart-healthy diets and physical activity among African Americans are fundamental to achieving desirable change (7). The National Prevention Strategy emphasizes the need for eliminating health disparities and contains a series of recommendations aimed at improving diets and physical activity levels (8). Complementary to population-based approaches is the need for clinical approaches in managing hypertension, dyslipidemias, and diabetes to eliminate health disparities in the treatment for abnormal levels of risk factors (9,10). Assuring access to quality medical care and availability of affordable medications will help in improving control of abnormal risk factor levels.

The different impressions conveyed by the trajectories for predicted 10-year risk of CHD and CVD may seem counterintuitive given that both risk algorithms use a similar set of risk factors to calculate risk. The risk algorithm for CHD uses both SBP and DBP but not treatment for hypertension, whereas the risk algorithm for CVD uses only SBP but does make an allowance for treatment of elevated blood pressure. Also, the manner in which the variables are specified in the risk algorithms differs. Moreover, angina pectoris, myocardial infarction, coronary insufficiency, and CHD death represented the endpoints used to develop the risk equation for CHD, whereas the aforementioned endpoints as well as ischemic stroke, hemorrhagic stroke, transient ischemic attack, intermittent claudication, and heart failure represented the endpoints used to develop the risk equation for CVD. An examination of the risk functions for congestive heart failure and stroke derived from Framingham Heart Study data shows different sets of predictors for the risk functions. For example, the risk function for predicting congestive heart failure does not include lipids or smoking status, and the risk function for predicting stroke does not include lipids (11). Furthermore, there are differences in the strength of the relationships between the various risk factors employed by the risk equations and the specific endpoints that comprise CVD. Thus, the risk factors that were part of the risk equations for CHD and CVD may be more specific to CHD than to CVD. These differences may have accounted in whole or in part for the different trajectories in predicted risk.

Conclusions

Since 1999 to 2000, predicted 10-year risk for CHD has declined significantly but modestly. In contrast, the small decline in predicted 10-year risk for CVD was not statistically significant. The trend in predicted 10-year risk for CHD is consistent with regional U.S. reports about declining incident CHD and suggests that a future decline in the incidence of CHD is possible. Nevertheless, the modest size of the improvements in predicted risk cautions that future gains in cardiovascular health cannot be automatically assumed and indicates that much work in advancing cardiovascular health in the United States looms ahead.

Acknowledgments

The findings and conclusions in this article are those of the author and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Abbreviations and Acronyms

CHD	coronary heart disease
CVD	cardiovascular disease

DBP	diastolic blood pressure
HDLC	high-density lipoprotein cholesterol
SBP	systolic blood pressure

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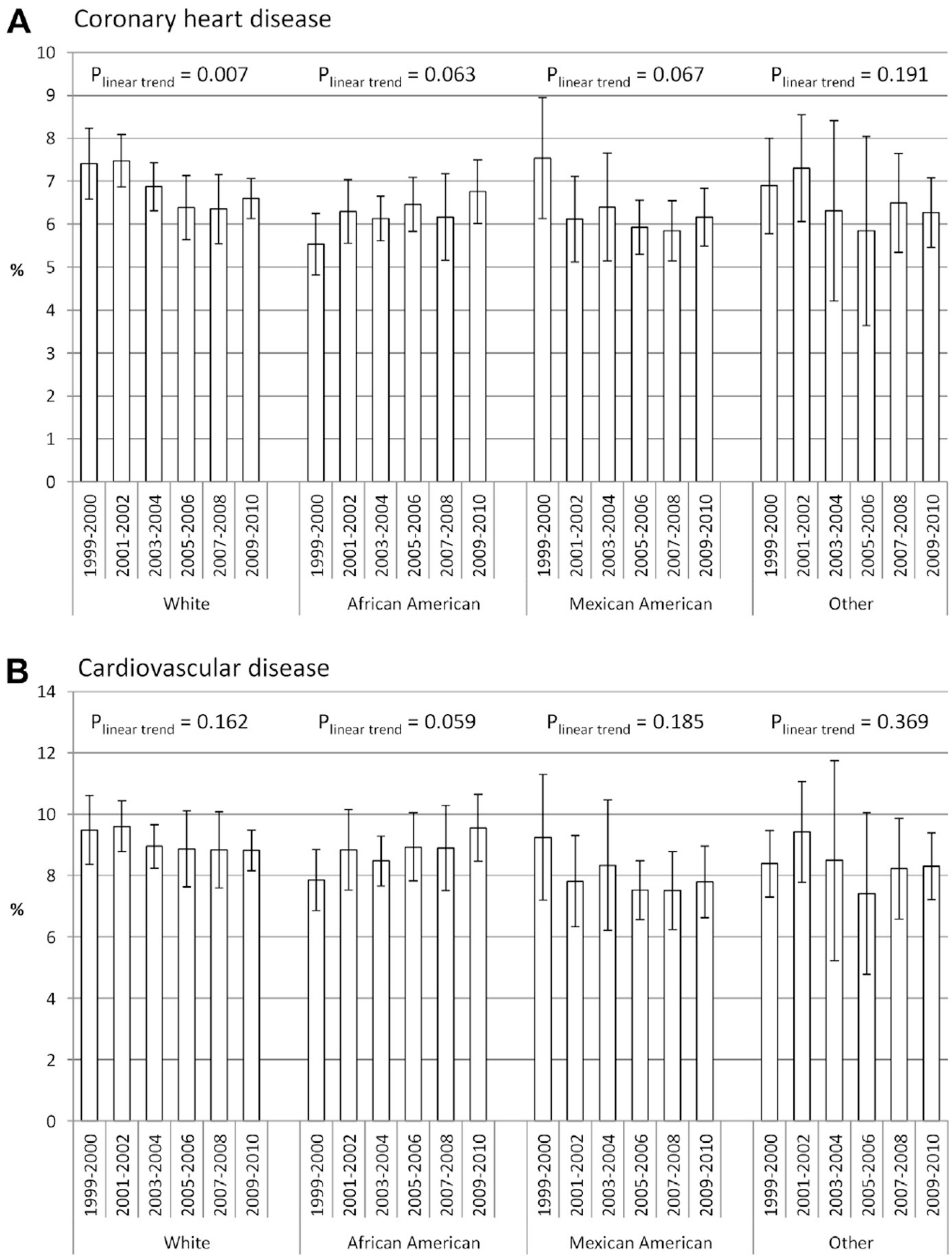

Figure 1. Projected 10-Year Risk for CHD

Mean (95% confidence interval) projected 10-year risk for (**A**) coronary heart disease (CHD) and (**B**) cardiovascular disease for 7,751 adults age 30 to 74 years, by race or ethnicity and survey period, National Health and Nutrition Examination Survey. Mean predicted 10-year risk for CHD among white adults decreased significantly, whereas mean predicted risk for CHD and cardiovascular disease among African-American adults increased nonsignificantly.

Table 1

Sociodemographic Variables, Risk Factors, and Projected 10-Year Risk for CHD and CVD Among Adults Age 30 to 74 Years, National Health and Nutrition Examination Survey

	1999–2000	2001–2002	2003–2004	2005–2006	2007–2008	2009–2010	p Linear Trend
Number	1,140	1,272	1,103	1,122	1,476	1,638	
Age, yrs*	46.9 (0.6)	47.4 (0.4)	47.4 (0.5)	48.1 (0.7)	48.5 (0.6)	49.2 (0.4)	0.001
Men, %†	48.7 (1.4)	48.9 (1.0)	48.3 (1.0)	46.9 (1.4)	47.5 (1.8)	47.9 (1.2)	0.476
White, %†	71.3 (3.1)	75.5 (2.9)	75.6 (3.8)	72.1 (2.7)	71.2 (3.5)	69.3 (3.3)	0.348
High school education or more, %†‡	76.5 (1.3)	84.1 (1.1)	83.8 (1.8)	85.2 (1.8)	82.3 (1.3)	83.1 (1.3)	0.005
Systolic blood pressure, mm Hg*	122.1 (0.8)	122.3 (0.6)	121.5 (0.7)	121.2 (0.7)	119.5 (0.7)	118.8 (0.5)	<0.001
Diastolic blood pressure, mm Hg*	74.1 (0.5)	74.5 (0.5)	72.8 (0.5)	70.8 (0.5)	71.7 (0.4)	70.2 (0.7)	<0.001
Blood pressure treatment, %†	15.7 (1.7)	17.4 (1.4)	18.7 (1.5)	19.3 (1.4)	23.5 (1.2)	22.8 (1.9)	<0.001
Total cholesterol, mg/dl*	208.0 (2.0)	207.0 (2.3)	204.3 (1.9)	204.2 (1.9)	200.7 (1.9)	202.0 (1.6)	0.003
HDLC, mg/dl*	50.3 (0.9)	51.8 (0.5)	54.4 (0.8)	56.0 (0.3)	54.0 (0.6)	54.6 (0.6)	<0.001
Diabetes mellitus, %†	7.3 (0.9)	9.2 (1.1)	8.3 (1.0)	8.1 (1.1)	8.7 (0.5)	11.6 (1.0)	0.013
Current smoker, %†	22.7 (2.3)	25.0 (1.4)	25.5 (2.3)	24.4 (2.3)	21.1 (1.9)	17.1 (1.2)	0.009
CHD 10-yr risk, %*							
Total	7.2 (0.3)	7.3 (0.2)	6.7 (0.2)	6.3 (0.3)	6.3 (0.3)	6.5 (0.2)	0.005
30–39 yrs	2.8 (0.2)	2.8 (0.2)	2.3 (0.2)	2.3 (0.1)	2.3 (0.2)	2.5 (0.1)	0.064
40–49 yrs	5.5 (0.4)	5.9 (0.3)	5.5 (0.2)	5.2 (0.3)	4.4 (0.2)	4.8 (0.2)	<0.001
50–59 yrs	10.4 (0.7)	9.5 (0.4)	9.1 (0.6)	8.2 (0.4)	8.9 (0.4)	8.1 (0.4)	0.002
60–74 yrs	14.5 (0.4)	14.8 (0.6)	13.2 (0.7)	11.9 (0.5)	11.2 (0.3)	11.6 (0.5)	<0.001
Men	9.5 (0.4)	9.8 (0.4)	9.1 (0.5)	8.4 (0.3)	8.7 (0.4)	8.6 (0.3)	0.006

	1999–2000	2001–2002	2003–2004	2005–2006	2007–2008	2009–2010	p Linear Trend
Women	5.0 (0.3)	4.8 (0.2)	4.5 (0.2)	4.5 (0.3)	4.1 (0.2)	4.7 (0.2)	0.039
CVD 10-yr risk, %*							
Total	9.2 (0.4)	9.4 (0.3)	8.8 (0.3)	8.6 (0.4)	8.7 (0.5)	8.7 (0.2)	0.152
30–39 yrs	2.9 (0.2)	2.9 (0.1)	2.5 (0.1)	2.6 (0.1)	2.6 (0.1)	2.7 (0.1)	0.138
40–49 yrs	6.3 (0.5)	7.0 (0.4)	6.4 (0.3)	6.4 (0.4)	5.6 (0.3)	5.7 (0.2)	0.014
50–59 yrs	12.6 (0.8)	11.9 (0.6)	11.8 (0.9)	10.3 (0.6)	11.6 (0.5)	10.2 (0.4)	0.007
60–74 yrs	21.4 (0.6)	22.1 (1.0)	19.8 (1.0)	19.4 (0.9)	17.7 (0.8)	18.0 (0.7)	<0.001
Men	11.8 (0.7)	12.4 (0.6)	11.9 (0.7)	11.2 (0.5)	12.0 (0.6)	11.5 (0.4)	0.480
Women	6.6 (0.3)	6.6 (0.2)	5.9 (0.3)	6.3 (0.6)	5.6 (0.3)	6.2 (0.2)	0.048

*Mean (SE).

†Percentage (SE).

‡Sample size was 7,743 for education.

CHD = coronary heart disease; CVD = cardiovascular disease; HDLC = high-density lipoprotein cholesterol.