

# Combating the Epidemic of Heart Disease

Daniel Levy, MD

AT THE BEGINNING OF THE 20TH CENTURY, THE 3 leading causes of death in the United States were infectious diseases—pneumonia, tuberculosis, and diarrhea—which in combination claimed 539 lives per 100 000.<sup>1</sup> Lurking in the background as the fourth leading cause of death was heart disease (137 deaths per 100 000). But this would change. With life expectancy of only 47 years at the beginning of the century, people did not live long enough for heart disease to claim many lives. Without a means for accurate diagnosis, many deaths from heart disease went unrecognized. With the advent of the electrocardiogram to facilitate the diagnosis of heart disease, antibiotics to treat infectious diseases, and increasing life expectancy, the number and proportion of deaths due to heart disease soared. During the Great Depression, the number of deaths due to heart disease was twice that of the next leading cause of death (pneumonia). In 1945, at the time of President Roosevelt's fatal brain hemorrhage due to decades of uncontrolled hypertension, heart disease accounted for more deaths in the United States than the next 3 causes combined. Deaths due to heart disease peaked in 1968 at 374 per 100 000.

Necropsy studies of soldiers killed in the wars in Korea and Vietnam provided an opportunity to define the prevalence of subclinical coronary atherosclerosis in young people. In 1953 Enos et al<sup>2</sup> described coronary lesions discovered at autopsy in 300 male soldiers (mean age, 22 years) killed in the Korean War. Gross evidence of coronary disease was present in 77% of the decedents: 35% with fibrous thickening, 26% with a coronary artery narrowed by 10% to 49%, and 15% with a coronary occlusion of 50% or more. In 1971, McNamara et al<sup>3</sup> reported evidence of coronary atherosclerosis in 45% of 105 Vietnam War combat deaths (mean age, 22 years), with 5% having severe coronary disease. In their concise descriptive narratives, these studies provided unequivocal evidence of the silent burden of coronary atherosclerosis in young, otherwise healthy adults, and in finding a "reservoir" of carriers of disease, they helped explain the emergence of heart disease as a 20th century epidemic among middle-aged and older adults.

See also p 2577.

In this issue of JAMA, Webber and colleagues<sup>4</sup> report on the prevalence of coronary and aortic atherosclerosis in 3832 US service members who died from combat or unintentional injuries from 2001 to 2011 while serving in support of military operations in Iraq or Afghanistan. With a mean age of 27 years, the service members' prevalence of coronary atherosclerosis of any degree was 8.5%, a value considerably lower than reported by Enos et al<sup>2</sup> (77%) and McNamara et al<sup>3</sup> (45%). Minimal, moderate, and severe coronary atherosclerosis were present in only 1.5%, 4.7%, and 2.3% of the recent decedents, respectively. The large sample size of the study provided robust estimates of the low burden of subclinical atherosclerotic disease and permitted an exploration of differences in prevalence of disease across various demographic strata. The prevalence of atherosclerosis increased with age and was greater in those with lower education levels but was not associated with occupation, ethnicity, service branch, or military rank.

Taken together, the reports by Enos et al,<sup>2</sup> McNamara et al,<sup>3</sup> and Webber et al<sup>4</sup> offer cross-sectional perspectives on subclinical atherosclerosis in healthy young military service members, but unlike standardized, population-based, cross-sectional studies (eg, the National Health and Nutrition Examination Survey [NHANES], for example), these studies are not directly comparable and also might not be generalizable to the US population of young adults. Unlike NHANES, the 3 autopsy studies were conducted at irregular intervals and were restricted to military personnel who were likely to be healthier than the US population as a whole. The restrictive criteria used by Webber et al to establish the presence of cardiovascular disease risk factors, along with the "healthy warrior effect," may have resulted in low measures of prevalence of key risk factors. Specifically, the prevalence of obesity (4%), smoking (3%), hypertension (1%), dyslipidemia (0.7%), and impaired fasting glucose (0.2%) were markedly lower than among comparable age groups in the US population<sup>5</sup> or compared with published estimates of risk factor prevalence in the military.<sup>6</sup> The methods used for ascertainment of several risk factors likely underrepresented their true prevalence and limited the authors' ability to draw conclusions about risk factor associations with

**Author Affiliation:** National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda, Maryland.

**Corresponding Author:** Daniel Levy, MD, The NHLBI Framingham Heart Study, 73 Mount Wayte, Ste 2, Framingham, MA 01702-5827 (levyd@nhlbi.nih.gov).

atherosclerotic cardiovascular disease. Webber et al found that obesity, hypertension, and dyslipidemia were each associated with approximately a doubling in the prevalence ratios for atherosclerosis. The prevalence ratios, however, may be exaggerated because only the most severe manifestations resulted in an inpatient or multiple outpatient encounters required for the diagnosis of hypertension, dyslipidemia, or diabetes/impaired fasting glucose. Also, cigarette smoking and diabetes/impaired fasting glucose, 2 risk factors well known to be associated with atherosclerotic cardiovascular disease, were not associated with atherosclerosis by autopsy.

However, the autopsy case series offers advantages over other designs for detecting associations of risk factors with pathological changes of atherosclerosis. Because postmortem information was available and because the decedents were selected without regard to the exposures (cardiovascular risk factors) or the outcomes (coronary and aortic atherosclerosis) of interest, the design of the study of Webber et al<sup>4</sup> is unlikely to have introduced systematic biases due to sampling or outcome measurement. Consequently, it is highly likely that the main finding of this study is valid: the prevalence of atherosclerosis in young men today is much lower than the prevalence in the Korean or Vietnam War eras. If these findings are generalizable to the US population as a whole, then the cardiovascular health of the US population may have improved appreciably over the past 6 decades.

The study by Webber et al<sup>4</sup> is not well suited to address the root causes of this favorable trend or of the parallel declines in deaths from heart disease in the United States. However, evidence available from other sources indicates that the decline in heart disease mortality is attributable both to advances in treatments for patients with clinical heart disease (ie, secondary prevention) and successful primary prevention strategies resulting in improvements in modifiable cardiovascular disease risk factors in individuals free of heart disease. On balance, primary and secondary prevention strategies are believed to have contributed about equally to national declines in heart disease mortality.<sup>7</sup> Advances in primary (but not secondary) prevention are likely to explain the declines in coronary atherosclerosis across the 3 autopsy studies.<sup>2-4</sup>

During recent decades there have been steady declines in several key cardiovascular disease risk factors in the United States. First, the proportion of individuals who smoked cigarettes declined from about 50% of men and 30% of women in the mid-1960s to about 20% in both sexes in 2010.<sup>5,8</sup> Second, from 1976 to 2008, there were improvements in awareness, treatment, and control rates for hypertension (defined as blood pressure  $\geq$  140/90 mm Hg). The proportion of individuals with hypertension aged 18 to 74 years who were treated for hypertension and whose blood pressure was controlled to less than 140/90 mm Hg increased from 10% to 49% over this time period.<sup>5,9</sup> Third, the proportion of men and

women with elevated cholesterol levels of 240 mg/dL or greater declined by about 50% in men and women over the same interval.<sup>5,9</sup> In contrast, worrisome upward trends in obesity and diabetes threaten to reverse favorable risk factor trends. From 1976 to 2008, the prevalence of overweight increased for men and women within each racial/ethnic group.<sup>5,10</sup> Today 69% of adults in the United States are overweight or obese.<sup>10</sup> As a consequence of national obesity trends, the prevalence of diabetes is increasing; from 1958 to 2010, the proportion of adults and children in the United States diagnosed with diabetes increased from 1% to 7%.<sup>11</sup>

Autopsy studies have demonstrated that coronary disease begins at a young age. Consequently, primary prevention campaigns to address obesity and related risks should begin in childhood.<sup>12</sup> Declines in cardiovascular disease risk factors have almost certainly contributed to the observed reductions in prevalence of subclinical atherosclerosis, incidence of clinical atherosclerotic disease, and deaths from heart disease. Although age-adjusted heart disease death rates have declined by 72% since their peak during the Vietnam War years, cardiovascular disease remains the leading cause of death in the United States.<sup>5,13</sup> The national battle against heart disease is not over; increasing rates of obesity and diabetes signal a need to engage earlier and with greater intensity in a campaign of preemption and prevention.

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