

Trends in Coronary Atherosclerosis: A Tale of Two Population Subgroups



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ABSTRACT

BACKGROUND: We previously investigated trends in subclinical coronary artery disease and associated risk factors among autopsied non-elderly adults who died from nonnatural causes. Although grade of atherosclerosis declined from 1981 through 2009, the trend was nonlinear, ending in 1995, concurrent with increasing obesity/diabetes in this population. The previous study used linear regression and examined trends for all 4 major epicardial coronary arteries combined. The present investigation of coronary artery disease trends for the period 1995 through 2012 was prompted by a desire for more detailed examination of more recent coronary artery disease trends in light of reports that the epidemics of obesity and diabetes have slowed and are perhaps ending.

METHODS: This population-based series of cross-sectional investigations identified all Olmsted County, Minnesota residents aged 16-64 years who died 1995 through 2012 (N = 2931). For decedents with nonnatural manner of death, pathology reports were reviewed for grade of atherosclerosis assigned each major epicardial coronary artery. Using logistic regression, we estimated calendar-year trends in grade (unadjusted and age- and sex-adjusted) for each artery, initially as an ordinal measure (range, 0-4); then, based on evidence of nonproportional odds, as a dichotomous variable (any atherosclerosis, yes/no) and as an ordinal measure for persons with atherosclerosis (range, 1-4).

RESULTS: Of 474 nonnatural deaths, 453 (96%) were autopsied; 426 (90%) had coronary stenosis graded. In the ordinal-logistic model for trends in coronary artery disease grade (range, 0-4), the proportional odds assumption did not hold. In subsequent analysis as a dichotomous outcome (grades 0 vs 1-4), each artery exhibited a significant temporal decline in the proportion with any atherosclerosis. Conversely, for subjects with coronary artery disease grade 1-4, age- and sex-adjusted ordinal regression revealed no change over time in 2 arteries and statistically significant temporal increases in severity in 2 arteries.

CONCLUSIONS: Findings suggest that efforts to prevent coronary artery disease onset have been relatively successful. However, statistically significant increases in the grade of atherosclerosis in 2 arteries among persons with coronary artery disease may be indicative of a major public health challenge.

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KEYWORDS: Atherosclerosis; Cardiovascular disease; Subclinical coronary artery disease; Time trends

Funding: This work was supported by grants from the National Institutes of Health (R01HL59205) and the A. J. and Sigismunda Palumbo Charitable Trust and was made possible using Rochester Epidemiology Project resources. Rochester Epidemiology Project is supported by the National Institute on Aging (R01AG034676). The funders had no role in the design, conduct, reporting, or submission of findings.

Conflict of Interest: None.

Authorship: All authors had access to the data and a role in writing the manuscript.

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Heart disease mortality in the United States has fallen steadily since the 1970s (Figure 1).¹⁻³ Declines have been attributed to both decreased incidence of clinically evident heart disease (eg, hospitalized myocardial infarction) and improved survival among persons with heart disease.⁴⁻⁶ Multiple factors have been implicated as contributing to declining incidence, including increased use of pharmaceuticals for hyperlipidemia/hypertension/type 2 diabetes mellitus, reductions in the prevalence of smoking, and other lifestyle improvements, including increased exercise among certain sectors of the population.^{7,8}

Although declining heart disease incidence and mortality are suggestive of a continuing amelioration of this major public health problem, duration of these trends is unclear. Although the overall rate of deaths due to heart disease in the United States continues to decline,⁸⁻¹³ a few investigations from the United States and Europe have observed a leveling off or increase in heart disease deaths among some age (sex) groups.¹⁴⁻¹⁶ It has been proposed that observations of an end to declines in mortality might have resulted from substantial increases in 2 major risk factors for coronary artery disease, namely diabetes mellitus and obesity.¹⁵⁻¹⁹

In previous studies conducted in Olmsted County, Minnesota, we demonstrated that, consistent with declines in hospitalized myocardial infarction and heart disease mortality,^{6,9} there was an overall decline in severity of subclinical coronary artery disease from 1981 through 2004; however, the rate of decline was nonlinear, with the decline having ended in the mid-1990s.²⁰ A subsequent investigation identified risk factors and trends in coronary artery disease 1981 through 2009 to estimate contributions of increasing obesity and diabetes mellitus in this population to the slowing of declines in subclinical coronary artery disease.²¹ Both studies of subclinical trends used autopsy data from non-elderly county residents whose manner of death was “nonnatural” (ie, accident, suicide, homicide, or undetermined). In general, there is minimal autopsy referral bias in this group because the autopsy rate is very high (96%) and the decision to autopsy by the Medical Examiner is largely unrelated to coronary artery disease.

The calendar years considered in our latest previous study (ie, 1981-2009)²¹ occurred before recent reports that the prevalence of obesogenic risk factors (eg, sedentary life style and high-fat diets) has declined^{22,23} and that the marked increases in obesity and diabetes mellitus have slowed and for some subgroups have ended.²³⁻²⁸ To address implications of these reports, the

present study updates temporal trends of coronary artery disease for Olmsted County residents aged 16-64 years who died from nonnatural causes and were autopsied, to determine whether rates rose, fell, or remained constant from 1995 through 2012. The investigation of trends in coronary artery disease in the present report is also more detailed than that conducted in our previous article, the focus of which was trends in risk factors.²¹ In our previous investigation, grade of atherosclerosis was treated as a continuous variable; each individual was assigned a mean value for all 4 major epicardial coronary arteries combined; and analyses used linear regression.

CLINICAL SIGNIFICANCE

- Of all Olmsted County, Minnesota autopsied decedents aged 16-64 years who died nonnatural deaths, the percentage with any coronary artery disease (grade >0) declined 1995 through 2012 in all 4 coronary arteries.
- Among persons with grades 1-4, there was either no change (2 arteries) or a significant increase over time (2 arteries).
- Although efforts to prevent coronary artery disease seem relatively successful, results seem less encouraging for those with disease.

METHODS

This population-based series of cross-sectional investigations was conducted in Olmsted County, Minnesota (2010 US Census, n = 144,248). Because Rochester, the county seat, is relatively isolated from other metropolitan areas and is home to one of the world's largest medical centers, Mayo Clinic, essentially all medical care received by local residents is provided either by Mayo Clinic or a second group practice, Olmsted Medical Center (OMC), and their affiliated hospitals. Since 1907, every Mayo Clinic patient has been assigned a unique identifier. Information from every Mayo Clinic contact (ambulatory, hospital, emergency department, and nursing home visits), including pathology reports, copies of death certificates, diagnoses assigned at each visit, and autopsy information, is contained within a single file for each patient. Under auspices of the Rochester Epidemiology Project, and with continued funding from the National Institutes of Health, the diagnostic index and medical records linkage were expanded to the few other providers of medical care to local residents.²⁹

All autopsies performed on residents who die in Olmsted County have been conducted in Mayo's Department of Laboratory Medicine and Pathology using a uniform comprehensive system of autopsy techniques.^{30,31} Death certificates of almost all residents cared for by Mayo physicians are completed by the Medical Examiner or a Mayo autopsy pathologist. Infrequently, death certificates are completed by oncologists for hospice patients, and by internists for nursing home patients. Death certificates for patients cared for by physicians affiliated with other institutions (eg, OMC) are completed by physicians from those institutions. The entire medical record is reviewed to assign cause of death; autopsy findings take precedence over clinical information.

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