

## II. FEATURES OF CARDIOVASCULAR DISEASE PREVENTION AND THERAPY UNIQUE TO THE ELDERLY

### Prevention of Cardiovascular Disease in the Elderly

WILLIAM B. KANNEL, MD, FACC, CHAIR, JOSEPH T. DOYLE, MD, FACC,  
ROY J. SHEPHARD, MD, PhD, JEREMIAH STAMLER, MD, FACC,  
PANTEL S. VOKONAS, MD, FACC

With an increasing proportion of the population reaching advanced age, cardiovascular disease\* has become an urgent public health concern because it is among the most common and disabling cause of physical impairments that afflict the elderly. Elimination of the morbidity associated with cardiovascular disease through preventive measures would do much to decrease chronic disability and to improve the quality of the last years of life.

The incidence of most clinical manifestations of cardiovascular disease increases dramatically with advanced age, and women tend to lose much of their risk advantage over men. Cardiovascular diseases, including coronary heart disease, stroke, cardiac failure and peripheral arterial disease, account for most of the mortality in the senium. However, cardiovascular disease should not be considered an inevitable concomitant of the aging process. Autopsy in the elderly, even the very aged, often reveals atheroma-free coronary arteries, a normal-sized heart and unscarred valves (1).

#### Risk Factors in the Elderly

Most risk factors known to contribute to cardiovascular disease are highly prevalent in the aged. These include hypertension, elevated cholesterol levels, diabetes, obesity and physical inactivity. Only cigarette smoking appears to decline with advancing age. Although these risk factors are all modifiable, doubt has been expressed as to the relevance of risk modification in the elderly. It is universally accepted that the risk of cardiovascular disease in middle life can be predicted from a readily assembled profile including arterial hypertension, cigarette smoking, hypercholesterolemia, diabetes, obesity, physical inactivity, a family history of premature cardiovascular disease and, possibly, type A behavior. Data from Framingham (2-6) and other epidemiologic studies clearly demonstrate that most risk factors continue to contribute to cardiovascular disease incidence in older persons (Table 1). However, there appear to be some dif-

ferences in the risk associations for certain factors in the elderly.

**Serum cholesterol level.** Although total serum cholesterol level loses strength as a predictor of cardiovascular disease in older persons, fractionation of cholesterol into its low and high density lipoprotein components restores the predictive value of these lipid levels (Table 2) (7). This suggests that blood lipid levels continue to influence the rate of thromboatherogenesis in the aged and that a fat-modified diet may be of preventive value, particularly if continued from an earlier age.

**Cigarette smoking.** The influence of cigarette smoking on cardiovascular disease in general diminishes with advancing age. However, cigarette smoking remains a significant risk factor for intermittent claudication and stroke (3-6) for both men and women.

**Diabetes.** Diabetes makes an independent contribution to cardiovascular risk, particularly in older women (8,9). Its influence on cardiovascular disease is undiminished in advanced age (Table 1). Diabetes in women markedly decreases the female risk advantage over that of men.

**Obesity.** Substantial obesity, particularly with a central fat distribution, predisposes to cardiovascular disease in the elderly (4,10).

**Hypertension.** The risk of arterial pressure elevation is not linear but exponential; the curve slopes upward with advancing age. Age itself is as potent a predictor of a cardiovascular end point as is arterial pressure. Elevated systolic blood pressure that continues to rise progressively with advancing age confers a substantial risk for all major forms of cardiovascular disease in the elderly, irrespective of the level of diastolic pressure. Elevated diastolic pressure is common and is also hazardous in the elderly.

**ECG abnormalities.** The electrocardiogram (ECG) is useful in predicting cardiovascular disease in the elderly (11,12). ECG evidence of left ventricular hypertrophy, intraventricular conduction disturbances and repolarization abnormalities all predict cardiovascular disease in the elderly (Table 1).

**Vital capacity.** Vital capacity declines with age, and is worsened by cigarette smoking (13,14). When diminished,

\*This principally encompasses coronary heart disease, stroke, cardiac failure and peripheral arterial disease.

**Table 1.** Impact of Risk Factors on Cardiovascular Disease Incidence\* by Age in Men and Women at 30 Year Follow-up: Framingham Study

Risk Factor	Multivariate Logistic Regression Coefficients† at			
	Age 35 to 64‡		Age 65 to 94‡	
	Men	Women	Men	Women
Systolic pressure	341§	0.361§	0.410§	0.207§
Diastolic pressure	0.302§	0.288§	0.259§	0.089**
Serum cholesterol	0.230§	0.202§	0.091*	0.040**
Blood glucose	0.087 <sup>†</sup>	0.176§	0.146§	0.173§
Relative weight	0.080*	0.134 <sup>†</sup>	0.044**	0.052**
Vital capacity	-0.089*	-0.252§	-0.109**	-0.216§
Cigarettes	0.333§	0.183§	0.045**	0.083**
ECG-LVH	0.121§	0.112§	0.142§	0.229§
Intraventricular block	0.049**	0.075*	0.096*	0.096*
NSA-ST-T	0.052**	0.130§	0.187§	0.147§

\*Coronary events, stroke, cardiac failure and peripheral arterial disease. †Covariates for each variable cited in Risk Factor column: blood pressure, cholesterol, cigarettes and electrocardiographic evidence of left ventricular hypertrophy. ‡Age at biennial examination. § $p < 0.001$ ; <sup>†</sup> $p < 0.01$ ; \* $p < 0.05$ ; \*\*not significant. ECG-LVH = electrocardiographic evidence of left ventricular hypertrophy; NSA-ST-T = nonspecific ST segment and T wave abnormalities.

it is strikingly associated with the excessive development of cardiovascular disease (15). It is a powerful predictor of cardiac failure.

**Heart rate.** A rapid heart rate at rest, that is,  $>84$  beats/min, also indicates an increased risk of cardiovascular disease, including cardiac failure, coronary disease and sudden death (4).

**Cardiovascular risk profiles.** These profiles, consisting of the standard risk factors, retain usefulness in older persons, defining risk over a wide range. These profiles may identify individuals with increased risk due to multiple borderline abnormalities, individuals who would otherwise not be detected (16). Despite a lesser relative impact of some risk factors in advanced age, these risk profiles are nearly as efficient in predicting cardiovascular disease in the elderly as in younger persons (2,4) (Table 3). Profiles that also

include low and high density lipoprotein cholesterol subfractions, vital capacity and heart rate may enhance precision in predicting cardiovascular disease in the elderly.

## Preventive Recommendations

Ideally, preventive measures should be initiated early in life to reduce the ultimate burden of cardiovascular disease in both young and old, but such measures instituted in the aged should not be considered valueless. The incidence of cardiovascular disease in older persons varies widely in relation to modifiable risk factors. Because incidence rates of cardiovascular disease are high in the elderly, preventive measures could have a substantial impact on older persons.

The decline in cardiovascular mortality in the United States and some other industrialized nations also has in-

**Table 2.** Influence of Serum Lipids on Coronary Heart Disease Incidence in Elderly Men and Women 50 to 82 Years of Age at 4 Year Follow-Up: Framingham Study

	Standardized Logistic Multivariate Coefficients*	
	Men	Women
Cholesterol		
High density	-0.610 <sup>†</sup>	-0.650 <sup>†</sup>
Low density	0.332‡	0.260§
Triglyceride	-0.092	-0.106

\*Covariates: systolic blood pressure, electrocardiographic evidence of left ventricular hypertrophy, relative weight and diabetes. <sup>†</sup> $p < 0.001$ ; <sup>‡</sup> $p < 0.01$ ; <sup>§</sup> $p < 0.05$ . (Reprinted with permission from Gordon T, et al. [7].)

**Table 3.** Efficiency of Coronary Risk Profile\* by Age and Sex at 16 Year Follow-up: Framingham Study

Age (yr)	Percent of Coronary Events in Top Decile of Multivariate Risk	
	Men	Women
45 to 54	26	20
55 to 64	27	26
65 to 74	21	41

\*Based on: systolic blood pressure, serum cholesterol, number of cigarettes smoked/day, glucose tolerance and electrocardiographic evidence of left ventricular hypertrophy.

**Table 4.** Declines in U.S. Cardiovascular Mortality 1963 to 1981

Age (yr)	Percent of Decline by Age	
	Coronary Mortality	Stroke Mortality
35 to 44	45	46
45 to 54	38	42
55 to 64	38	53
65 to 74	37	53
75 to 84	30	50
≥85	26	44

From the National Center for Health Statistics, adjusted for seventh revision of the International Classification of Diseases.

volved the elderly (Table 4). This indicates that environmental influences on cardiovascular disease incidence extend to older persons. These secular trends in mortality are correlated with corresponding changes in known risk factors for cardiovascular disease in both young and old (17,18). Thus, comprehensive risk factor modification seems a reasonable option in older as well as younger persons.

Most cardiovascular disease risk factors, including hypertension, dyslipidemia, impaired glucose tolerance, cigarette smoking, obesity and physical deconditioning, are both highly prevalent and modifiable in the elderly.

Dietary change, weight control, avoidance of cigarettes and treatment of hypertension can favorably influence the risk profile of the elderly. Although no randomized controlled trials have been performed on modification of risk factors in the elderly except for hypertension (37-40), optimism as to likely efficacy is justified (19-21).

**Control of dyslipidemia, obesity and diabetes.** Serum total and low density lipoprotein cholesterol can be lowered by decreased intake of cholesterol and saturated fat, with partial replacement of the saturated fat by polyunsaturated fat from vegetable and fish sources, by increased intake of water-soluble fiber and by reduction of overweight (19-21). Recent studies have shown a relation between the quantity and character of dietary fats, including fish oils, and coronary heart disease mortality (22-24). At least two recently completed controlled trials in younger populations have shown that reducing serum cholesterol by diet and drugs can lower coronary morbidity and mortality (25,26). The fat-modified diets required are nutritionally adequate, safe, convenient, inexpensive and palatable. Obesity aggravates all atherogenic traits in both young and old. Weight control with a well balanced fat-modified diet is a major hygienic approach for improving all the atherogenic risk factors in young and old people (27-31). Preventive measures for the elderly diabetic at high risk for cardiovascular disease should include reduction of overweight; control of elevated blood pressure by dietary and, if needed, drug therapy; control of

blood lipids and avoidance of cigarette smoking, in addition to control of blood sugar.

**Cigarette smoking.** It is likely that smoking contributes to thrombotic occlusion and is a risk factor for occlusive peripheral arterial disease in the elderly (3-6,32). Cigarette smoking is also a major contributor to chronic bronchitis, emphysema and lung cancer in the elderly.

**Regular physical activity.** This should be encouraged in the elderly because overall and cardiovascular mortality rates apparently are benefited at all ages, including the elderly (33,34).

**Control of hypertension.** Hypertension is a major remediable risk factor for cardiovascular disease in the elderly because of its high prevalence and sustained impact in advanced age (35,36). Hypertension control should lessen the incidence of stroke, cardiac failure and renal insufficiency (37-44). Although the efficacy of correcting isolated systolic hypertension has not been demonstrated, its impact on risk in the elderly is established, early experience with its treatment is encouraging and a full-scale controlled trial is underway (35,36,41-44).

### Impediments to Preventive Approaches in the Elderly

There are a number of impediments to implementing preventive programs for cardiovascular disease in the elderly. Foremost is the propriety of modifying life styles already compatible with superior longevity. The psychologic and social impacts of such interventions are not known. Common sense dictates a conservative, individualized approach, particularly in the very old. However, the elderly are good consumers of health education and they comply with advice at least as enthusiastically as younger adults. Correspondingly, physicians should be encouraged to give hygienic advice to the elderly and to aid them in improving living habits. Regrettably, many regard cardiovascular disease in the elderly as inevitable and do not think that ingrained habits can be changed. Patients and their families often regard the infirmities of old age as an inevitable burden that must be endured. There is a reluctance to undertake uncomfortable or expensive procedures. The result is sometimes indifference or benign neglect. Ethical considerations mandate that persons identified by risk profiling as vulnerable to cardiovascular disease should be counseled to modify their life-styles appropriately. The aged who require such interventions can be identified by ordinary office procedures and simple laboratory tests on routine health examinations.

Physicians experienced in the care of the elderly observe that most elderly persons are concerned about their health, follow therapeutic recommendations closely and adhere to prescribed medications at least as well as younger persons. Preventive approaches are feasible, and can profitably and

appropriately be extended to the growing older segment of the population.

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Polypill Prevention of Secondary Cardiovascular Disease Cardiovascular Disease Myocardial Infarction Cardiovascular Combination Polypill AAR Cardiovascular Disease in the Elderly Adherence. SECURE Elderly Secondary Cardiovascular Disease Secondary Cardiovascular Prevention Randomized Cardiovascular Trial Randomized Trial Cardiovascular Polypill. Additional relevant MeSH terms: Layout table for MeSH terms. Neoplasm Metastasis Myocardial Infarction Infarction Cardiovascular Diseases Ischemia Pathologic Processes Necrosis Myocardial Ischemia Heart Diseases Vascular Diseases Neoplastic Processes N Objective: The objective is to review the evidence evaluating the efficacy of statin therapy for primary prevention of cardiovascular (CV) disease in the elderly. Data Sources: A literature search of MEDLINE and PubMed (1966-January 2013) using the terms HMG-CoA reductase inhibitor, statin, primary prevention, elderly, and geriatrics was performed. The search was limited to clinical trials, meta-analyses, and subanalyses, including primary prevention patients. Bibliographies of selected articles were examined to identify additional clinical trials. Study Selection: Fourteen clinical trials, su Prevention of cardiovascular disease : guidelines for assessment and management of total cardiovascular risk. 1. Cardiovascular diseases " prevention and control. 2. Arteriosclerosis " prevention and control. The debilitating and often fatal complications of cardiovascular disease (CVD) are usually seen in middle-aged or elderly men and women. However, atherosclerosis " the main pathological process leading to coronary artery disease, cerebral artery disease and peripheral artery disease " begins early in life and progresses gradually through adolescence and early adulthood (15"17).