

The Classic Risk Factors for Coronary Heart Disease: Experience in Europe¹

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This article is based on the follow-up of 9,182 men from 13 cohorts of five European countries (Finland, Greece, Italy, Holland, and Yugoslavia). Its purpose is to explore the associations of known risk factors for coronary heart disease (CHD). A significant positive association was found between age and 10-year mortality from CHD (10-MCHD), between systolic blood pressure (SBP) and 10-MCHD (steeper for the Finns than for men from Mediterranean countries), and between serum cholesterol and 10-MCHD (more pronounced in northern than southern European men). Age-standardized 10-MCHD was found to increase with degree of smoking; the regression slope of this correlation was steeper for men from northern than from southern Europe. Although death from all causes tended to be inversely related to relative body weight, no consistent evidence of a relation between relative body weight or body fatness and CHD was found. Incidence rate of CHD was not consistently related to physical activity characteristics of the groups. Resting pulse rate was an important risk factor for all causes of death in 10 years, but of less consequence for MCHD. Regression slopes were steeper for northern than for southern Europeans. Vital capacity was a significant risk factor for MCHD for Italian but not for Finnish, Greek, or Serbian men. The 10-year adjusted MCHD was correlated with total fat in the diet; the correlation with saturated fatty acids was much more significant.

This article is based on a report by Keys and associates (1) of a 10-year follow-up of 9,182 men of five European countries and the relationships of age, blood pressure, serum cholesterol, smoking, overweight and obesity, physical activity, resting pulse rate, respiratory function, and diet to coronary heart disease (CHD).

Age. A positive linear relationship was found between age and 10-year mortality from CHD. A steeper slope was found in the relationship of age and 10-year mortality from all causes. The influence of age as a risk factor for 10-year mortality from CHD was not the same for every cohort.

Blood pressure. An important relationship across the cohorts ($r:0.64$) was found between median systolic blood pressure (SBP) and 10-year age-standardized CHD death rates. Regional differences regarding the effect of blood pressure on the within-cohort probability of 10-year mortality from CHD were also noted. At all blood pressure levels the Mediterranean (Italian and Greek) men were much less likely to die from CHD as compared with the Finns. Systolic and diastolic blood pressures were equally important, and only in a few cases did the SBP seem to have a slight advantage over the diastolic blood pressure (DBP).

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Serum cholesterol. The relationship between serum cholesterol level and death from CHD across cohorts was found to be significantly positive. The relationship between median serum cholesterol and 10-year all-causes mortality was also positive, but not significant. When data for each group of cohorts were examined separately the following results emerged: Northern European men in the top cholesterol quintile had significantly higher deaths from CHD than the men in the bottom quintile. The probability of this association varied from significant for the Finns to highly significant for the Dutch men. In Southern European men this association varied from probably significant for Italians and Greeks (pooled together) to nonsignificant for men of the Serbian cohorts. In every group of cohorts, except for the Italians and the Croatians, the incidence rate of hard CHD and all forms of the disease was significantly higher in men with serum cholesterol in the top cholesterol distribution quintile than in men in the bottom quintile.

Smoking habits. When the men of each cohort were classified by smoking habits at entry, the following picture emerged: Among Northern European men (Finns and Dutchmen) death rates from CHD as well as from other causes rose progressively with the average number of cigarettes smoked. This trend was less impressive, yet still significant, especially for all-causes death, in men of the Yugoslavian cohorts. For Southern Europeans some indication of a relation was found, but it was of smaller degree.

Overweight and obesity. Across the cohorts, a nonsignificant negative association was found between the age-standardized 10-year mortality from CHD and the mean for each cohort of body mass index, or their mean sum of skinfold thickness. A nonsignificant negative association was also found between the age-standardized 10-year all-causes death rate and the same two variables.

Physical activity. A distinct tendency for all-causes mortality to fall with increasing percentage of relatively sedentary men was found across the cohorts, whereas CHD death was unrelated to the percentage of sedentary men in the cohorts. The incidence of any form of CHD was also unrelated.

Resting pulse rate. Across cohorts, mean resting pulse rate had no significant relationship to all-causes or CHD death. A consistent inverse relationship of resting pulse rate to physical activity and vital capacity was noted for all cohorts. All-causes and CHD death rates tended to rise with increasing resting pulse rate when data for each cohort were analyzed separately.

Respiratory function. After adjustment for age and body size, vital capacity was a highly significant risk factor for all-causes deaths for the men of each cohort except for the Greeks. Vital capacity was not significantly related to the diagnosis of any CHD for men from any of the areas.

Diet. The 10-year incidence rate for CHD was correlated in low order with percentage of calories from total fats, but its correlation with percentage of calories from saturated fatty acids was significantly positive. Although significant correlation with calories provided by sucrose was observed, this can be explained by the intercorrelation of sucrose with saturated fats in the diet. No significant correlation was found between calories provided by proteins or by polyunsaturated fatty acids and CHD incidence. These findings do not prove that

TABLE 1
CALORIES PER DAY IN THE DIET OF GREEK COHORTS

	Crete		Corfu	
	1960	1979	1961	1980
<i>N</i> (observations)	30	36	40	32
Calories				
Total (per day)	2,769	3,063	2,796	3,563
Fats	1,158	1,069	956	1,050
Proteins	282	399	313	442
Carbohydrates	1,271	1,486	1,291	1,597
Alcohol	58	109	234	474

saturates in the diet cause an increase in total mortality, but are consistent with the concept that the risk of early death is increased by dietary saturates. The suggestion that a diet restricted in saturated fats as protection against CHD may be offset by increased noncoronary mortality is not supported by these findings.

The two rural cohorts in Greece presented the lowest CHD and all-causes death rates. Entry examinations did not show substantial differences between them regarding their risk profile. As time went by, accumulation of deaths during a 20-year period showed that the Corfu cohort (Northern Greece) presented higher death rates from both CHD and any other cause than the Crete cohort (Southern Greece). Analyses of dietary data showed, at the beginning of the study (1960), the Corfu cohort exhibited a higher daily consumption of calories from proteins and alcohol, while the Cretans consumed more calories from fats, mainly from olive oil. As to total daily calories, differences between the two cohorts were not significant. Analysis of dietary data 20 years later (1980) showed that both cohorts presented higher mean intakes of total calories compared with 1960, as well as higher intakes of calories from most food constituents. Percentage of calories from protein, carbohydrate, and alcohol increased in both cohorts by widely varying rates. The trend for the percentage of calories from fats was different; in Corfu an increase of 9.8% was observed, while in Crete a decrease of 7.7% was observed, thus offsetting the previously significant difference. Changes in the

TABLE 2
FATTY ACIDS, GRAMS PER DAY IN THE DIET OF GREEK COHORTS

	Crete		Corfu	
	1960	1979	1961	1980
Saturated	16.9	25.9	12.1	27.1
Oleic	100.3	63.1	79.8	62.1
Monounsaturated	101.7	73.4	81.7	74.8
Linoleic	10.8	11.1	14.5	10.7

intake of fatty acids were most pronounced for the saturated ones. An increase of 123% was observed for Corfu and 53.8% for Crete. At the same time a decrease in daily intake of oleic acid by 27.8% for Crete and 8.4% for Corfu was observed (Tables 1 and 2).

REFERENCES

1. Keys, A., Ed. "Seven Countries. A Multivariate Analysis of Death and Coronary Heart Disease." Harvard Univ. Press, Cambridge, Mass., and London, 1980.