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Scientific base for the population strategy to CHD prevention.

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A population strategy for the prevention of coronary heart disease (CHD) and the major atherothrombotic diseases includes an effective medical approach to high risk individuals plus an efficient public health approach to population risk overall, including socially influenced behaviors. The scientific evidence is based on the following salient points in the epidemiology of atherosclerotic diseases;

Large population differences exist in the frequency of CHD;

Large population differences exist in the means and distributions of the major physiological risk characteristics for CHD;

Significant positive population (ecologic) correlations are found between average risk factor values and population rates and risk of disease;

Dynamic trends in national death rates from CHD and other cardiovascular diseases have occurred in the last two decades, predominately upward in very low incidence populations and downward in very high risk ones;

Changes in risk factor levels and disease rates of migrant populations are in the direction of those in the adopted culture;

Within populations, strong individual correlations exist between physical risk factors measured in health and subsequent risk of atherothrombotic diseases;

Computations of the population attributable risk fraction indicate that about 75% of excess CHD cases occur in the central part of the TC distribution, between 220-310 mg/dl;

A general trend is found of lower CHD risk in single and multifactor trials of risk factor lowering;

Substantial public health impact on disease rates occurs with relatively small changes in average population risk characteristics;

Experimental studies show clearly the modifiability of major individual and population risk characteristics;

Clinical trials of risk factor lowering (mainly blood lipids) show lower CHD risk

according to extent and duration of exposure to the lower values;

There is clear evidence of dramatic trends nationally in many health behaviors related to CHD risk, i.e. eating, exercise and smoking patterns.

Population differences in disease rates

National differences in death rates for CHD are confirmed by systematic surveys and follow-up observations designed to reduce spurious observations. These differences are on the order of 5 to 10 fold between middle-aged men in different cultures, first examined in health and followed from one to three decades. Dramatic, though less systematically observed differences in death rates, are found between countries reporting national vital statistics. For example, high rates have been reported in northern Europe, the U.S., Australia, New Zealand and the British Isles, low rates in the Mediterranean Basin and the Orient, with intermediate rates in Central Europe.

Within high risk populations, regional differences are commonly found, on the order of 2 to 3 fold, as for example, between the eastern seaboard of the United States, the midwest and the western states, and as well, between east and west Finland and between the Flemish and French sections of Belgium.

Population risk factor differences.

Systematic comparative observations across populations show significant mean differences in serum cholesterol and blood pressure levels and cigarette smoking habit. Numerous less systematic studies confirm the large population differences in the distributions of these characteristics and their clustering, in populations and in individuals.

Population risk factor/disease correlations

Significant population correlations are established between average single risk factors (and multiple risk factor scores) and population CHD risk. The strongest correlations are between average total or LDL cholesterol levels and coronary disease rates. This correlation explains most of the variance in CHD rates among populations. The evidence from population comparisons of disease and risk factors indicates the universal importance of the major risk factors for coronary disease, but particularly the fact that relative hypercholesterolemia is a necessary factor for substantial population risk. Cultures with average cholesterol values of 180 mg/dl or below are essentially free of atherosclerotic diseases. Those with average levels between 180 and 220 have intermediate rates and those with values over 220 are generally found to have high coronary disease rates. Because dietary saturated fat intake is the major determinant of population levels of total cholesterol and LDL, relatively high saturated fat intake is a necessary factor for mass disease (i.e. intakes above 10% of daily calories). In no populations studied systematically was there a significant amount of atherosclerotic disease where saturated fat intake is less than 10% of daily calories, irrespective of the total fat intake or the level of other risk factors.

Individual risk factor/disease correlations within populations.

Where there is a substantial population burden of CHD, total cholesterol (LDL), average blood pressure and number of cigarettes smoked are all important, and relatively equally important, in individual risk of coronary disease. HDL-C and HDL-C/total cholesterol ratios are also strongly predictive of individual risk and

are independent of other risk characteristics in most but not all populations. In some populations, for example, Framingham, the inverse relationship of HDL and CHD is stronger than the relationship for total or LDL cholesterol, at least in age groups above age 55.

Individuals' apolipoprotein values do not yet significantly enhance the disease prediction now available from lipoprotein measurements, but the evidence is still meager.

Population trends.

Making provision for differences in the International Classification of Causes of Death, there have been remarkable trends in CHD death rates upward and downward in the last three decades in countries reporting vital statistics. In the countries with the highest CHD rates, there have been declines on the order of 1-3% per year, reaching levels of 40% overall decline since the mid-1960's. In the United States the decline involves all age groups, both sexes and all racial groups. The trend downward continues through 1986, though there is evidence of a less steep decline since 1983. Other countries, particularly in eastern Europe have shown rises in coronary disease death rates of comparable magnitude, while others have changed little, such as the United Kingdom and parts of central Europe and Scandinavia.

Many attempts have been made to correlate changes in the means and distributions of risk factors with changes in disease trends. In a general sense, populations that are on the upswing economically from very low levels, consistently show rises in CHD death rates whereas populations that have been high risk, and are showing favorable changes in risk behavior, in eating, exercise and smoking patterns, and control of blood pressure, tend to show a decline in death rates. However, these parallelisms have not been established by systematic, geographically controlled comparisons and there are a number of exceptions and paradoxes in this evidence that resist good documentation and explanation. For example, the decline in coronary death rates in women and in Blacks in the U.S. is out of proportion to the apparent change in the risk characteristics of those subpopulations.

Migrant studies.

Migrant studies consistently show rapid changes in risk factors and disease rates in migrant populations in the direction of findings in the adopted country, with some residual effect of the country of origin. This has been documented primarily in the Ni-Hon-San study of Japanese in Japan, Hawaii and the U.S., and in the Boston Irish Brothers Study.

Clinical trials.

Statistical summaries of clinical trials of blood cholesterol lowering have shown a consistent effect on CHD risk, despite the fact that few trials individually have had sufficient statistical power. A summary suggests that short term exposure to cholesterol lowering, on the order of two to three years, results in a 1% fall in coronary disease risk for a 1% fall in total cholesterol or LDL cholesterol level. Similarly, with a longer exposure, for 2-7 years, the ratio of disease to cholesterol change is 2-to-1. These ratios in trials and among high risk persons contrast to the approximately 3-to-1 relationship found between cholesterol differences and coronary heart disease risk differences within high risk populations. Adjustment of the individual correlation of total cholesterol to coronary risk for the effect of single measurement variability results in a

stronger correlation, on the order of that found between population mean TC and population CHD risk.

Risk factor modifiability.

Despite considerable genetic heterogeneity in blood lipid response to diet, under experimental conditions in humans, group responses are precisely predictable with formulae such as the Keys and Hegsted equations. Clinical trials demonstrate the clear potential of modifying each of the major risk characteristics. The relative force of change in the average risk factor characteristics for populations is greater in terms of public health impact than a comparable risk factor change in the individual.

Population attributable risk.

Careful examination of the excess coronary cases attributable to elevated serum cholesterol (and other risk characteristics), at various points along the distribution of those characteristics, indicates that the bulk of excess cases comes from the center of the distribution. This establishes greater benefit/cost for high risk individuals of a medical strategy, and a greater benefit/cost consideration for the public health from a population-wide strategy. The benefit/cost of a public health strategy is superior to that of a medical strategy in terms of lowering the overall disease burden. Nevertheless, in affluent cultures having a strong concern for individual lives, it is considered ethical and feasible to identify a large proportion of susceptibles in the population and to involve them in effective, if relatively costly preventive medical therapy. A combined high-risk, medical preventive strategy, with a public health strategy, is therefore the optimal one for affluent societies where the goal is maximal reduction of risk for the both individual and the population. A public health strategy to prevent elevated risk in the first place is the optimal strategy for youthful populations and for societies around the world not yet heavily burdened by atherosclerotic diseases.