SESSION I

Chairman: SIR CYRIL CLARKE

Life style and national and international trends in coronary heart disease mortality

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Summary

An international comparison of trends in mortality from coronary heart disease (CHD) since 1968 shows a sizeable decline in the U.S.A., Australia, New Zealand, Finland, Canada, Belgium and Japan. By contrast England, Wales and Scotland had shown no evidence of decline in CHD mortality until 1979. This has resulted in a marked deterioration in the CHD ranking of Scotland and England and Wales relative to other countries. Sweden, Hungary, Poland, Yugoslavia, Bulgaria, Rumania and the U.S.S.R. have all had increases in CHD mortality. There are many possible reasons for these changes. In general, countries that had had a decrease in CHD mortality have experienced changes in the type and/or quantity of fat in the national diet. The changes in CHD mortality in Sweden and Japan are out of line with the pattern in other countries. There is some evidence that changes in smoking and blood pressure control may have contributed to changes in CHD mortality. Changes in physical activity may have also played a part.

Risk factors—true or false?

A great deal of misinformation is disseminated about risk factors and coronary heart disease (CHD). On the one hand we have the exaggerated claims that we now have sufficient information to prevent coronary disease; and on the other, we have had inquests on the diet-heart hypothesis, and announcements that we have reached the end of the diet-heart era. At some point reference is inevitably made to the decline in CHD in the U.S.A. and elsewhere (Editorial, 1980). The 'diet-hypothesis-is-finished' school commonly takes the view that "we don't even know

why heart disease is declining in the U.S.A.", and this provides further evidence for the uselessness of conventional wisdom on the importance of diet, smoking and blood pressure. They add to this the 'negative' results of the recent American Multiple Risk Factor Intervention Trial (MRFIT) (1982) and wonder that the prevention activists can credibly still put their case.

The case for the other side points to the declining CHD mortality in America as evidence for success of preventive efforts. For them, the MRFIT results do not prove that prevention is impossible. Rather, they may be interpreted as showing that two groups of volunteers modified their risk factors, and two groups had a lower than expected CHD mortality. The difference between the groups in risk factors was insufficient to detect a significant difference in CHD.

Where lies the truth? Numerous expert committees have summarized the evidence, such as the recent WHO expert committee (1982), relating plasma cholesterol, blood pressure, smoking and other risk factors to the occurrence of CHD, and the likelihood that the amount and quality of dietary fat plays an important part in the aetiology of CHD. These factors do not, however, account for all variations in the occurrence of CHD (Marmot *et al.*, 1978a).

Analysis of recent time trends in CHD mortality in different countries will not, *per se*, settle unresolved issues on the aetiology of coronary heart disease. It is, of course, correct to say we do not know with certainty why the American CHD rates have declined. It is certainly not correct to imply that we have no idea, and that examination of time trends does not add to knowledge on the possibilities for prevention. There are inconsistencies in the evidence, and numerous observations that do not fit precisely with any single hypothesis. Nevertheless,

examination of trends in different countries is instructive and encourages the belief that CHD rates may be changed in the short term, and that prevention efforts may play a role in this.

CHD mortality trends nationally and internationally

The data in Figs. 1 and 2 come from successive World Health Statistics Annuals (1965–1979) and are age-adjusted by the direct method. The latest figures for England and Wales (E&W) were supplied by the Office of Population Censuses and Surveys. They include mortality statistics classified under the 8th, and from 1978, under the 9th Revision of the International Classification of Diseases (I.C.D.).

FIG. 1. Coronary heart disease mortality 1968–1981 in selected countries men aged 35–74 years. Age-adjusted rates/100,000.

Among men, there has been a marked decline in CHD mortality in the U.S.A., Australia and, to a lesser extent, Finland. Until 1978, CHD mortality in England, Wales and Scotland had been static. Hence, the U.S.A. rates which had been more than one-third higher than those in England and Wales in 1968 had, by 1978, dropped below England and Wales. Cautiously, we may observe that 1979 seems to have

FIG. 2. Coronary heart disease mortality 1978–1981 in selected countries women aged 35–74 years. Age-adjusted rates/100,000.

marked the start of a decline in England and Wales and Scotland (Heller, Hayward and Hobbs, 1983). Japan, with very low CHD mortality, has shown a continued decline in rates; Sweden, interestingly, has shown an increase.

Among women (Fig. 2), the picture is not greatly different except that more countries show a decline. CHD mortality figures up to 1979, for men and women aged 40–69 years, have been brought together by Pisa and Uemura (1982) and are shown in Figs. 3 and 4 for men and women. Notable among countries with a rising CHD mortality are Hungary, Bulgaria, Romania, Yugoslavia, and Poland. Figures for the U.S.S.R. are not made available to W.H.O., but such figures as are available point to an increasing CHD mortality (Cooper, 1981).

To go back further in time entails crossing revisions of the I.C.D. and making groupings of I.C.D. categories. This has been done in an earlier analysis (Marmot, Booth and Beral, 1981) and shows, in several countries, that a decline in non-rheumatic heart disease and hypertension began earlier in women than in men. Trends in national mortality rates mask differential trends within a country. In England and Wales, successive decennial supplements on occupational mortality showed heart disease mortality in social classes IV and V to have increased more rapidly than in I and II (Marmot *et*

FIG. 3. Average percentage change in mortality from ischaemic heart disease for males aged 40 to 69 years in 1968-1977 (based on the slopes of linear regressions fitted to mortality trends in the 6 quinquennial age groups). From Pisa and Uemura (1982) by permission.

FIG. 4. Average percentage change in mortality from ischaemic heart disease for females aged 40 to 69 years in 1968-1977 (based on the slopes of linear regressions fitted to mortality trends in the 6 quinquennial age groups). From Pisa and Uemura (1982) by permission.

al., 1978b). We await 1981 figures to assess this trend further.

British doctors have shown a decline in CHD mortality, not seen in the national averages (Doll and Peto, 1976). In the Whitehall study of civil servants, where we observed a markedly higher mortality in the lower grades of employment (Marmot *et al.*, 1978a), there has been no change in the relative position of the grades over the 10 years of follow-up.

A decline in incidence or case-fatality?

The real answer to this question is that we do not

know. To answer this question W.H.O. is co-ordinating the MONICA project which is gathering data on trends in risk factors, CHD incidence and mortality in 40 countries. Partial answers to the question can be attempted however. Figures from the W.H.O. myocardial infarction registries show a high correlation between attack rates of acute myocardial infarction and mortality rates of acute myocardial infarction, gleaned from national vital statistics (Pisa and Uemura, 1982). This suggests that differences between countries in CHD mortality are unlikely to be due to differences in case-fatality. Epstein's (1983) comprehensive review suggested that in the U.S.A., a

decline in incidence is likely, but there may also have been an improvement in prognosis after a myocardial infarction, i.e. a reduced case-fatality.

If, as seems likely, there has been a decreased incidence in those countries that have had a decreased CHD mortality, it is important to consider the factors which may have been responsible. As these will be dealt with by other contributors to this conference, they will only be dealt with briefly here.

Diet

Much of the attention, and most of the controversy, has centered on the possible role of dietary fat in explaining the rise and fall of coronary heart disease. In the U.S.A., figures for consumption of total fat as a per cent of all calories consumed show an increase from 1909 to 1967 (Fig. 5), thereafter it remains static (Page and Marston, 1979). The type of fat consumed has changed markedly: a progressive increase in vegetable fat and a decrease since the 1950s in animal fat. This has resulted in an increased consumption of the essential fatty acid, linoleic acid, and a decrease in saturated fatty acids. Between 1963 and 1980 there was a 24% decrease in butter, a 12% reduction in eggs, a 39% reduction in animal fats and oils, and a 58% increase in vegetable fats and oils, and a 22% increase in fish (Walker, 1983).

FIG. 5. Proportion of total calories from fats and fatty acids USA 1909-1978; based on food consumption statistics of the U.S. Department of Agriculture. From Page and Marston (1979) by permission. *Preliminary. (TSFA = total saturated fatty acids).

Similarly, the American diet has changed markedly since the 1960s. It is not at all clear whether these changes can account for various differential changes within the country; but broadly the picture is consistent with a protective role for an increased ratio in the diet of polyunsaturated fatty acids, in particular the essential fatty acids, to saturated fatty acids.

In Finland, heart disease rates have declined in the

country as a whole and, in particular, in North Karelia where a community-wide intervention trial has been carried out (Salonen *et al.*, 1983).

There has been a national decrease in dairy fat consumption in Finland, but also an increase in meat, leading to little overall change in animal fat consumption (Pyorala and Valkonen, 1981).

In Australia, the decline in CHD has also been accompanied by a change in fat consumption, no change in eggs but a decrease in meat, butter, milk and cheese, and an increase in margarine consumption (Dwyer and Hetzel, 1980).

Further evidence than an increased linoleic acid consumption may be responsible for the decreased coronary mortality in the U.S.A. comes from a survey of adipose tissue biopsies in the U.S.A. and U.K. Katan and Beynen (1981) gathered together a number of diverse reports of the proportion linoleic acid makes of total fatty acids in adipose tissue. In the U.S.A., since the mid-1960s there has been a progressive increase. In the U.K., with no decline in CHD until 1979, the proportion remained more or less unchanged. In fact, in the U.K., the fat content of the diet may now be starting to change (National Food Survey Committee, 1977, 1982). Table 1 shows a decrease in butter consumption since 1975, and an increase in soft margarine (high in polyunsaturates) and an increase in vegetable and salad oils. These changes, as yet, are small, but it is not impossible that they are related to the small decline in CHD mortality.

Changes in salt intake, dietary fibre and vitamin C, may also be relevant, but this is too extensive a subject to be considered here.

The above data from the U.S.A., Australia, Finland and the U.K. are broadly in line with a protective role for essential fatty acids, and a harmful role for saturated fats—perhaps more the former than the latter. But these are only a few countries; with data up to 1974, representing 21 countries, we found little correlation between changes in fat consumption and changes in non-rheumatic heart disease and hypertension, with a 10-year time lag built in (Marmot *et al.*, 1981). Working with the same dietary data and CHD mortality 1969-75, Byington *et al.* (1979) found a positive correlation between CHD change and saturated fat, and a negative correlation with changes in calorie consumption from grains, legumes, fruit and vegetables.

Whichever analysis was 'correct', there are nevertheless significant exceptions which do not add weight to the dietary hypothesis. Sweden reports similar dietary changes to the U.S.A., but an increase in CHD mortality. Japan has had an increase in fat consumption and a decrease in CHD mortality. As is always the case with CHD, a one-factor explanation will simply not fit all the observed trends.

TABLE 1. Household food consumption in Great Britain from National Food Survey 1970-1980

	1970	1972	1975	1978	1980
Consumption per person per week					
Milk and cream (pints)	5.00	5.05	5.12	4.82	4.58
Butter (oz)	5.90	4.79	5.63	4.55	4.05
Margarine (oz)	2.82	3.52	2.60	3.54	3.83
soft	—	—	1.10	2.37	2.76
other	—	—	1.50	1.17	1.06
Vegetable and salad oils (fl oz)	0.61	0.60	0.64	0.81	1.06
g/1000 Kcal					
Fat	46	46	47	47	47
Saturated fatty acids	—	21.4	22.6	20.9	21.0
Monounsaturated fatty acids	—	17.7	17.4	17.4	17.7
Polyunsaturated fatty acids	—	4.7	4.4	4.7	5.1

Smoking

International comparisons of smoking trends are difficult. Data are available for sales of manufactured cigarettes and for sales of tobacco in g, but these do not always correspond; and these do not give the same picture as the prevalence of smokers. For example in 1980, sales of manufactured cigarettes and tobacco consumption per capita were higher in the U.S.A. than in the U.K., but the prevalence of smokers was higher in the U.K. (Cox and Marks, 1983). In the U.S.A. and Australia, tobacco sales have declined since 1960, consistent with a contribution to the coronary decline; but there has also been a decrease in tobacco sales in the U.K. which had no decrease in CHD until 1979 and in Sweden which had an increase (Cox and Marks, 1983). In the U.S.A. and Finland, surveys have shown a decrease in the prevalence of smoking among men but not women, but both sexes had reduced coronary mortality. Taking data from 21 countries, there is a small positive correlation between changes in consumption of cigarettes 1968-1977 and changes in heart disease (A83, A84 of the ICD) mortality in the same period (Marmot, 1983).

In the Soviet Union (Fig. 6), where heart disease mortality has increased, smoking has been increasing (Cooper, 1982) and a causal connection is possible.

Within England and Wales, we have seen a major change in the distribution of smoking by social class: an important decrease in the prevalence of smoking by upper income groups, less so by lower income groups. This may have contributed to the lowered CHD mortality in social classes I and II relative to IV and V (Marmot *et al.*, 1978b).

Blood pressure

It is difficult to determine whether blood pressure levels have decreased over time because of the ever-present possibility of drift in measurement. Mortality from cerebrovascular accident (stroke), has been

FIG. 6. Mortality from all causes and from cardiovascular disease and consumption of cigarettes and papyrosi per year in the U.S.S.R. (These are crude rates per 100,000. Age and sex-specific mortality rates were available 1966-1972 and show similar trends to the crude rates). From Cooper (1981 and 1982).

declining in many Western countries and started long before the CHD decline (Editorial, 1983). If, as has been suggested, a decrease in blood pressure were responsible for the decline in stroke, it follows that decrease in blood pressure *per se* cannot account for the CHD decline—otherwise CHD and stroke would have followed the same time curve. Nevertheless, both in New Zealand and the U.S.A., there has been an accelerated decline in stroke mortality in the later 1960s and 1970s (Editorial, 1983), suggesting that

treatment of blood pressure may have made a contribution to decreased stroke mortality. In Japan, where blood pressure treatment has been active, stroke and CHD mortality have declined. These latter data from New Zealand, U.S.A. and Japan would fit better with decreased blood pressure contributing to decreased coronary mortality. Once again, Sweden remains an exception that does not fit the pattern.

Other factors

The American jogging-craze is indisputable, and although hard figures are scarce, it seems likely that it began in the U.S.A. before it became popular in the U.K. 'Stress' is excluded from discussions of trends in mortality because of conceptual, definitional and measurement difficulties. It is mentioned here only as a reminder that although it is excluded for good reasons, something important may be missed.

Conclusion

There are numerous pieces of the puzzle which do not fit neatly into place. In the U.S.A., for example, CHD mortality has declined to a similar degree in both young and old, in men and women, in white and black. It seems unlikely that the changes in life style discussed should affect all subgroups equally. Sweden poses a particular challenge to explanation.

The difficulty with multifactorial explanations is that they can be stretched and twisted, *post hoc*, to cover almost any set of data. Nevertheless it would be a remarkable accident if the discussed changes in diet, smoking, blood pressure and physical activity were unrelated to the improved CHD picture in many countries. It seems likely that the trailing behind of the United Kingdom with respect to improvement in CHD mortality is the result of a trailing behind with respect to changes in life style.

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