

Diet, blood lipids and coronary heart disease — current controversies

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It has been known for years that a high blood cholesterol level is causally related to coronary heart disease (CHD). This belief is based on several lines of evidence. Many studies have demonstrated that individuals with a relatively high blood cholesterol level are at increased risk of CHD. Similarly, populations or groups whose customary diet causes a high blood cholesterol level have a high risk of CHD.¹ In several European countries during the Second World War there was a marked drop in the intake of fat-rich foods, which were replaced by carbohydrates and dietary fibre; these dietary changes were followed by a sharp fall in CHD mortality.^{2,4} Studies on non-human primates have repeatedly demonstrated that atherosclerosis develops as a consequence of a high blood cholesterol level.

Growing evidence has demonstrated that atherosclerosis is reversible. The original evidence for this came from studies in animals, particularly primates.^{5,7} In recent years studies using angiography have demonstrated that atherosclerosis can also be reversed in humans.⁸ This was clearly demonstrated in the recent St Thomas' Atheroma Regression Study (STARS) in which diet alone reversed atherosclerosis in less than 3 years.⁹ It therefore appears that atherosclerotic lesions are in dynamic equilibrium with the blood cholesterol (or, to be more precise, the low-density lipoprotein fraction thereof). There is a neutral point of about 4.2 - 4.6 mmol/l. Atherosclerotic lesions develop when the blood cholesterol level is above this point and reverse when under it. Moreover, the rate of development or reversal is roughly proportional to the difference between the blood cholesterol level and the neutral point.

Numerous clinical trials have tested the hypothesis that when the blood cholesterol level is lowered by diet or drugs, CHD mortality rates are reduced. As Alec Walker and I¹⁰ have pointed out, intervention does indeed prevent CHD, but to achieve a clinically meaningful impact on CHD occurrence there must be a significant reduction in blood cholesterol level; the minimum should be about 6% but a considerably larger decrease is preferable. Bearing in mind that many trials have achieved only a minor decrease in the blood cholesterol level, it is hardly surprising that the impact on CHD has often been disappointing.

Davey Smith *et al.*¹¹ recently analysed these trials. They separated those that used drugs from the others, almost all of whom used dietary means. Both types of trial showed that intervention to lower the blood cholesterol level is effective in preventing death from CHD. However, treatment with drugs also causes an increase in deaths from causes other than CHD, such as stroke and certain types of cancer. All types of drug appear to have this action. Diet, by contrast, does not cause an increase in non-CHD deaths. Davey Smith *et al.*¹¹ concluded that drugs are only warranted in subjects who are at exceptionally high risk for CHD, e.g. a person with a blood cholesterol level of over 6.5 mmol/l plus clinically evident CHD. For persons with a lower risk of CHD, drugs will cause a net increase in the number of deaths. At present far more people are receiving drug therapy than can be justified. Unless prescribing practices change, this may become the next drug scandal.

Diet, then, is the treatment of choice for the prevention of CHD, as it is both safe and effective. However, there has been much controversy as to the most appropriate dietary advice. The most common intervention is the Step I Diet (fat < 30% of energy, saturated fatty acids < 10%, cholesterol < 300 mg/day). However, Ramsey *et al.*^{12,13} pointed out that this diet typically causes only a 2% drop in blood cholesterol level. This

poor response is probably due, in the main, to insufficient compliance. More rigorous diets reduce the intake of fat to 20-30% of energy and that of saturated fat to 5-7%. Such diets achieve a fall in blood cholesterol level of 6% to over 20%.^{14,15} The diet is likely to be effective when strictly followed but, when the subject is insufficiently motivated, results may be disappointing.¹⁶

The fat that is removed from the diet should be replaced by fibre-rich carbohydrate foods. Soluble fibre, found in fruit and beans, has a modest hypocholesterolaemic effect.¹⁷ On the occasion of Alec Walker's 80th birthday it is particularly fitting to point out that back in 1955 he was the first person to suggest a possible relationship between a high-fibre diet and protection against CHD.¹⁸

Evidence has appeared in recent years that demonstrates the importance of other aspects of diet. There is growing evidence that trans-fatty acids may increase the risk of CHD. These fats are formed when vegetable oils are hydrogenated in order to harden them and extend their shelf life. This is commonly done in the production of margarine and the fats used in products such as biscuits, cakes and white bread.

In a prospective study in the USA of 85 000 nurses, the intake of trans-fatty acids was directly related to the risk of CHD; the relative risk was 1.5 when the highest and lowest quintiles were compared.¹⁹ Similarly, a case-control study in Greece reported an increased risk for CHD in persons who regularly used margarine for cooking.²⁰ There has been a trend in recent years in North America for fast food restaurants to use partially hydrogenated vegetable oils in place of beef tallow and tropical oils. Ironically, this substitution may be having the opposite effect of that intended.

Another important finding to emerge in recent years is the protective effect of anti-oxidants. Gey *et al.*²¹ reviewed the results from an interpopulation study, a case-control study and a prospective study. In each there was an increased risk of CHD at low plasma levels of anti-oxidants, with the following rank order: vitamin E >> carotene = vitamin C. This underlines the great importance of fruit and vegetables in a healthy diet. First, these foods are the sole source of carotene and vitamin C, and a significant source of vitamin E. Second, these nutrients also have the same protective effect against stroke. Third, fruit and vegetables substantially lower the risk of most types of cancer.²²

Growing evidence demonstrates that fish is protective against CHD. Several prospective studies have indicated that fish consumption is negatively related to risk of CHD.²³ In one randomised trial, fish or fish oil was fed to men with CHD.²⁴ This reduced CHD mortality by 33% but there was no reduction in non-fatal CHD. The principal route via which this protection occurs appears to be reduction of the tendency to develop thrombosis.²⁵ However, fish also induces a modest reduction in blood pressure, particularly in hypertensives.²⁶ The active ingredient in fish appears to be the long-chain omega-3 fatty acids.

The evidence presented here shows that diet can dramatically reduce the risk of CHD. Most important is the lowering of the blood cholesterol level. This requires a reduction in the intake of saturated fat and cholesterol to a level far below what is typically consumed by westernised populations. It is ironic that while many poorer populations, e.g. the blacks of South Africa, strive for a Western lifestyle, our endeavours encourage the better-off populations to move in the opposite direction, at least in respect of diet.

While modification of blood cholesterol level must be the first consideration with regard to reduction of CHD, other factors also have an important impact. Briefly reviewed are the effects of trans-fatty acids, anti-oxidants and fish. Each of these can potentially reduce the risk of CHD by 20% or more if

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intake is optimised. In addition, a much reduced salt intake can have a similarly beneficial effect (and an even greater effect on the risk of stroke).²⁴

There would be little point in preventing CHD if the lives saved were lost to other diseases. However, as described more fully in a forthcoming book,²⁵ a large body of evidence compels the conclusion that the changes to diet and other aspects of lifestyle required to prevent CHD are essentially the same as those required to prevent other Western diseases, such as stroke, diabetes, obesity and cancer of the colon and breast. This benefit has the great advantage of facilitating the task of implementing a population strategy for the prevention of CHD. After all when people calculate the cost/benefit ratio, they are much more likely to become motivated to switch to a healthier diet if the promised benefit is the prevention not only of CHD, but of most Western diseases. To use the American phrase: 'They get a bigger bang for the buck.'

In this review, the relationship between blood cholesterol and CHD is discussed briefly. Prevention of the disease necessitates reducing the fat content of the diet to 20 - 30% and saturated fat to 5 - 7% of energy requirements, with a greatly increased intake of foods rich in carbohydrate and dietary fibre. With a sufficient fall in blood cholesterol level, atherosclerosis can stop progressing and can start reversing. Drug treatment of a high blood cholesterol level is only justified in a small minority of subjects, because of the resulting increase in non-CHD deaths. Other aspects of diet are also discussed, namely trans-fatty acids, anti-oxidant nutrients and fish.

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