

Fat and fatty acids in relation to cardiovascular disease: an overview

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CARDIOVASCULAR DISEASE

Cardiovascular disease (CVD), principally CHD and stroke, is the principal cause of death and premature death in the UK. Though rates are declining, the UK continues to have amongst the highest rates in the developed world. Beyond its lethal effects, CVD underlies a much larger amount of non-fatal disease and ill health.

The causation of CVD is multifactorial. Though many contributors to risk have been identified, both constitutional and environmental, those which can reasonably be considered causal do not explain all the variation in the occurrence of these diseases. The major determinants of CHD risk are smoking, and the levels of blood pressure, blood cholesterol (principally LDL-cholesterol) and physical inactivity. A number of other factors have been linked to CVD risk, but in most cases no causal association has been established.

FATS IN THE HUMAN DIET

From before birth until old age, fats are major, and some essential, components of the human diet. Breast feeding is acknowledged to be the best way of feeding young infants. Breast milk contains approximately 50% of its energy as fat, and about half of this is saturated, although it also contains the metabolically important essential polyunsaturated fatty acids linoleic and linolenic acids, as well as significant amounts of the longer chain polyunsaturated fatty acids arachidonic and docosahexaenoic acids. During childhood, with its periods of rapid growth, this fat provides a concentrated, available and easily consumed source of the energy required for optimal development. In adulthood, as growth makes fewer demands on energy supplies, dietary fats continue to provide essential fatty acids, to act as a vehicle for dietary supply and intestinal absorption of fat-soluble nutrients, and to provide an easy-to-consume source of energy.

In general, the greater the fat content of the diet, the greater its concentration of energy, and diets which are more concentrated in energy make overconsumption of energy easier. Combined with a sedentary lifestyle, diets comprising about 40% energy or more tend to lead to positive energy balance. Over years, this leads to increasing storage of energy in adipose tissue and obesity. Obesity increases risk of CVD, at least partly by increasing blood pressure and blood cholesterol levels.

In addition, the composition of dietary fat can modulate metabolism. Saturated fatty acids of 12–16 C-chain length increase blood total, LDL- and HDL-cholesterol concentration, and the LDL:HDL ratio. *Trans* fatty acids increase LDL, but also decrease HDL levels; both potentially adverse effects. Polyunsaturates of the *n*-6 series (principally linoleic acid) tend to decrease LDL-cholesterol levels, while monounsaturates are probably essentially neutral with respect to cholesterol. Fatty acids of the *n*-3 series have not been shown to have consistent effects on blood cholesterol, although long-chain *n*-3

polyunsaturates are effective in reducing triacylglycerol levels, which may also independently contribute to cardiovascular risk.

LONG-CHAIN *n*-3 POLYUNSATURATED FATTY ACIDS

Particular effects have been ascribed to the long-chain *n*-3 polyunsaturated fatty acids found in fish oils, namely eicosapentaenoic and docosahexaenoic acids. Observational epidemiology links high consumption of these (though usually also with a low intake of saturated fatty acids and other population differences) with low mortality from CVD. It has been proposed that this might be due to an influence on blood platelets, reducing tendency to thrombosis, although experimental evidence in support of this is slight. One intervention study has confirmed that diets enriched with oily fish or fish-oil concentrate significantly reduce fatality from (though not incidence of) coronary events. It is thought that this might result from membrane stabilizing effects following incorporation of these fatty acids in the lipid bilayer of the myocardial cells. Small effects of higher intakes of *n*-6 and long-chain *n*-3 polyunsaturates in reducing blood pressure have been found, although the biological significance of this is uncertain.

CONCLUSION

Overall, modification of the amount and composition of fat in the British diet would be expected to affect the risk of CVD in the population by a number of mechanisms.