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Invited commentary

Ways to reduce saturated fat intake

Reduction of saturated fat intake would lower the risk of CHD, but how should this reduction be achieved?

Cis-unsaturated fatty acids or carbohydrates?

Current dietary guidelines emphasize a reduced intake of total fat. This means that (saturated) fatty acids should be replaced by carbohydrates. But are carbohydrates the optimal replacement? High-carbohydrate diets do indeed lower plasma LDL-cholesterol levels. However, both sugars and complex carbohydrates lower HDL-cholesterol and increase fasting triacylglycerol levels (Mensink & Katan, 1987, 1992) and these effects last as long as the low-fat-high carbohydrate diet is eaten (Ernst *et al.* 1980). Low HDL-cholesterol levels are associated with increased risk of CHD (Gordon *et al.* 1989; Kinosian *et al.* 1994), and many factors that reduce HDL-cholesterol levels, such as smoking, obesity and lack of physical exercise increase the incidence of CHD. Although we are not sure that diet-induced decreases in HDL increase CHD risk, diets that lower HDL-cholesterol levels should be viewed with caution (Katan *et al.* 1997).

An alternative to high-carbohydrate diets is to replace saturated fat with *cis*-unsaturated oils (oils rich in the *n*-9 *cis*-monounsaturated oleic or the *n*-6 *cis*-polyunsaturated linoleic acid, and some *n*-3 fatty acids) and leave the intake of total fat the same. Replacement of saturated fatty acids with *cis*-unsaturated fatty acids reduces LDL-cholesterol, with little decrease in HDL. *Cis*-unsaturated fatty acids considerably lower the total : HDL-cholesterol ratio (the strongest predictor of CHD in observational studies; Kinosian *et al.* 1994), while carbohydrates do not improve this ratio. These effects have been well established by controlled dietary trials (Mensink & Katan, 1992) and they are confirmed by the study of Williams *et al.* (1999) in the present issue of the *British Journal of Nutrition*.

Low-fat, high-carbohydrate diets are thought to provide benefits that offset their unfavourable effects on HDL-cholesterol and triacylglycerol levels. One of these benefits is weight loss. Indeed, populations that habitually consume low-fat diets are often quite lean (Seidell, 1998). However, controlled trials show that in affluent populations restriction of energy from fat and replacement by carbohydrates results in only modest reductions in body weight (Willett, 1998). These reductions are too small to compensate for the HDL-lowering effect of high-carbohydrate diets (Leenen *et al.* 1993). Also, the prevalence of obesity in the USA has increased considerably over the past 25 years, despite a concomitant decline in the intake of energy from fat. Thus, restricting fat intake does not always result in weight reduction. This may hold particularly for Western societies, where the typical low-fat food items available in the supermarket are often high in energy. We may be fooling ourselves if we think that foods high in carbohydrates, protein and fat replacers will stop the oncoming worldwide epidemic of obesity.

Another proposed benefit of high-carbohydrate diets is a reduction of cancer risk. However, the evidence that a high fat intake causes cancer is weak (World Cancer Research Fund/American Institute of Cancer Research, 1997; Department of Health, 1998). A high intake of *n*-3 fatty acids from fish may, if anything, offer some protection (de Deckere *et al.* 1998), and intake of oleic acid and of linoleic acid is not associated with cancer risk in human subjects (Gerber, 1997; Zock & Katan, 1998). Thus, *cis*-unsaturated fatty acids seem a suitable and safe replacement for saturated fatty acids to reduce CHD risk, in particular for people who are close to ideal body weight. Overweight people should reduce energy intake by lowering consumption of saturated fat and not replacing this with other nutrients; they should also eat less sugar and other refined carbohydrates.

Do different *cis*-unsaturated fatty acids have different effects on risk? The *n*-6 *cis*-polyunsaturated fatty acid linoleic acid may be somewhat more effective in improving the plasma lipid profile (Mensink & Katan, 1992; Clarke *et al.* 1997) than *n*-9 *cis*-monounsaturated oleic acid, but the impact of this difference on CHD risk is probably small. The *n*-3 *cis*-unsaturated fatty acids from fish (mainly eicosapentaenoic and docosahexaenoic acids) and plant oils (α-linolenic acid) may give additional protection, in particular against fatal CHD (Albert *et al.* 1998; Hu *et al.* 1999). These observations need to be tested in future studies but they do suggest that a diet high in a variety of *n*-3, *n*-6 and *n*-9 *cis*-unsaturated fatty acids might provide the optimum for reduction of CHD risk.

Implementation of dietary changes in the population

Controlled feeding trials (Mensink & Katan, 1992) predict that a major reduction in saturated fat intake would lower plasma total cholesterol by 10–15 % (Clarke *et al.* 1997). However, the results of dietary intervention trials in free-living subjects are generally disappointing (Ramsay *et al.* 1991; Tang *et al.* 1998). Targets for dietary change are seldom achieved and the resulting reduction in cholesterol is only 3–6 % over months (Tang *et al.* 1998) and even less over years (Ramsay *et al.* 1991), and intensive dietary counselling is needed to improve compliance. General recommendations to the public without individual dietary counselling are not very effective in lowering fat intake. Indeed, despite educational campaigns to lower total fat intake, the level of saturated fat intake in Europe remains considerably higher than desired (Ministry of Agriculture, Fisheries and Food, 1995; Ministry of Health, Welfare and

Sports, and Ministry of Agriculture, Nature Management and Fisheries, 1998). What can be done to attain more substantial reductions of saturated fat intake? The paper of Williams *et al.* (1999) points to some possible solutions.

Fat makes foods taste better, and diets rich in unsaturated oils may therefore be more acceptable to consumers than low-fat diets. Indeed, interventions that change the fatty acid composition of the diet without changing the total fat content are more effective than interventions that lower total fat intake (Sacks, 1994; Tang *et al*. 1998). In their 4-month intervention study in free-living subjects, Williams *et al.* (1999) reduced the intake of saturated fatty acids from some 16 % to 10 % of energy by replacing them with *cis*-monounsaturated fatty acids. They achieved this by replacing saturated fatty acids in a variety of foods with monounsaturated fatty acids. Spreads, 'ready meals', biscuits, puddings and breads were, apart from fatty acid composition, identical for both the saturated fat and the monounsaturated fat diet. The manufactured foods contained 60 % of total daily fat intake and were of similar quality and type as those available in British supermarkets. The target intake of fatty acids was successfully accomplished and the resulting reduction in total and LDL-cholesterol was 6–10 % without a decrease in HDL-cholesterol level (Williams *et al.* 1999). We cannot tell whether the subjects would have been equally compliant to a low-fat diet or to a longer-term monounsaturated fat diet. However, this study emphasizes the role of the food industries in reducing saturated fatty acid intake. If a large part of saturated fatty acids in processed foods on supermarket shelves could be replaced by *cis*-unsaturated fatty acids, consumers would improve their plasma lipid profile and CHD risk without any conscious effort. Food manufacturers succeeded in developing low-*trans* fatty acid margarines that are also low in saturated fat and higher in *cis*-unsaturated fat (Katan, 1995). Replacement of *trans*- and saturated fatty acids by healthier fatty acids might also be achievable for other foods. Replacing 40 % of saturated fatty acids in the total food supply by *cis*-unsaturated fatty acids (6 % of total energy intake in Britain) would lower CHD risk by at least 10 % (Stampfer *et al*. 1991; Mensink & Katan, 1992; Law *et al.* 1994). Because of the high incidence of CHD this would mean a large gain for public health.

Replacement of saturated and *trans* fats by unsaturated oils is more effective in improving the plasma lipid profile than replacement with carbohydrates and it might be easier to produce attractive goods high in *cis*-unsaturated fatty acids than low in total fat. If such fat-modified foods are sufficiently attractive, then they would provide an efficient way to reduce the incidence of CHD.

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