



Prevention of cardiovascular disease at a population level: Evidence on interventions to address dietary fats

The Heart of Mersey cardiovascular disease prevention programme in the UK

Launched in 2003, following a visit to Finland, the Heart of Mersey (HoM) cardiovascular disease (CVD) prevention programme aims to improve the health of the local population through structural changes at regional, national and European level.(1) Based on the evidence (ie raised blood cholesterol and blood pressure, and tobacco use)(2), HoM focuses on food and smoking. Among its core objectives are to reduce dietary saturated fat intake and levels of serum total cholesterol, and a major focus of its work is on interventions to achieve this.(1)

At a local level, HoM is engaged in a variety of pilot projects and campaigns which include:

- Engaging, educating and raising awareness among (health) professionals on the role of fats and translation of national / European policies to support the fats agenda
- Supporting local and national campaigns on the fats message
- A hospital food project to improve food provision for staff
- A nursery nutrition training programme for cooks

HoM incorporates the principles of the Finnish North Karelia project,(2) discussed later. But in recognition of differences between the two regions, and the evidence on effective population-based interventions, HoM primarily concentrates on influencing and engaging policy makers (as opposed to the population directly) to influence social policy to support prevention of CVD.

This paper reviews the evidence on which HoM is based, including the role of fats in CVD prevention; provides an overview on the evidence of effective population-based approaches; and makes recommendations for UK action on fats to address CVD in the UK population. The key messages are:

- **Excess consumption of saturated fat raises risk of CVD; unsaturated fat reduces risk of CVD**
- **The ratio of polyunsaturated to saturated fat is the strongest predictor of CVD in the population**
- **Population goals should be to replace dietary saturated fats with small amounts of unsaturated fats**
- **The evidence demonstrates that environmental modification, based on changing agriculture and food policies to alter availability and consumption of fats is the key to significantly reducing the risk of CVD at a population level; the costs are considered to be relatively low.**

Cardiovascular disease and cholesterol

Cardiovascular diseases are the leading cause of death in the UK, accounting for almost 200,000 deaths each year; approximately 53,000 deaths are premature, ie they occur in people under the age of 75 years.(3) Cholesterol levels powerfully influence CVD levels. A recent meta-analysis of data from 61 prospective cohort studies found that each 1mmol/L reduction in total blood cholesterol levels is associated with a halving of the risk of ischemic heart disease in people aged 40-49 years, and reduced by a third in those aged 50-69 years.(4)

“Bad” low density lipoproteins (LDL) contribute to plaque formation (atherosclerosis) when levels are high; the process begins in childhood(5). In contrast, high levels of “good” high density lipoproteins (HDL) reduce the risk of plaque formation. HDL cholesterol is raised by a healthy lifestyle eg physical activity, moderate alcohol and not smoking. Diets, and in particular, dietary fats have a significant impact on cholesterol as can be seen in Table 1.(6)

The bad dietary fats

Saturated fats: the major problem: Excessive intakes of saturated fat are the principal cause of elevated LDL levels in Western diets. UK intakes average at around 13% in adults and over 80% of the UK population exceed the maximum recommended intakes of 10% of food energy(3).

Trans fats: Trans fats raise the ‘bad’ LDL cholesterol and lower the ‘good’ HDL cholesterol, and therefore damage health. Evidence from both RCTs and prospective studies have demonstrated harmful effects on CHD

risk factors and outcomes.(7) A recent meta-analysis of randomised trails and prospective cohort studies found that replacing 1% of food energy from trans fats with plant-based unsaturated fats reduced CHD risk by 12%.(7) The UK Government recommends maximum trans fat intakes of up to 2% of total energy. Average intake levels for adults are 1.0% of energy,(8) but a minority on low income consume up to 6%.(9)

Table 1: Effects of different types of fats on cholesterol levels and cardiovascular disease

Type of fat	Examples of dietary sources	Effect on cholesterol	Effect on CHD
Trans fat	Junk foods including cakes, pastries, crisps, take-away foods	Raise	Replacing 1% of energy from trans fats with unsaturated fats reduces CHD risk by 12% (7)
Saturated fat	Dairy products, red meat, biscuits, savoury snacks, processed foods.	Raise	Replacing 1% of energy from saturated fats with unsaturated fats reduces CHD risk by about 2-3%(10)
Plant sterols	Fortified soft margarines and yoghurts; fruits and vegetables, nuts	Consuming 3g/d reduces LDL cholesterol levels, by 10%-30%(11)	Consuming 3 g/d reduces CHD risk by about 25%-50%(11).
Polyunsaturated fat	Sunflower, corn oil, soya bean oil.	Replacing 10% calories from sat fat with omega 6, associated with a 18mg/dL decrease in LDL cholesterol (7)	Replacing sat fats is associated with a 25% reduced of CHD (7)
Oily fish and omega 3 oils (plus other benefits)	<i>Oily fish:</i> mackerel, sardines, herring, trout. Also soya beans, walnuts and their oils; green leafy vegetables.	Lower	Consuming 250mg or 1 portion per week reduces risk by 36% compared to not consuming any (12)
Monounsaturated fat	Olive oil, rapeseed oil, nuts, avocado.	Consuming 40g nuts per day reduces cholesterol levels by 4%(13,14)	Lower

Adapted from: Fats & Cholesterol Nutrition Source, Harvard School of Public Health (2004).

The good fats

The good fats include the unsaturated fats – monounsaturated fats, omega 3 polyunsaturated fats (PUFA) and omega 6 polyunsaturated fats. These primarily protect against CVD through their effects on cholesterol ie lowering harmful LDL cholesterol and raising protective HDL cholesterol.

Omega 6 oils: A large body of evidence supports the health impact of linoleic acid (the principle omega 6 oil) including meta analyses of clinical trials, and long-term prospective cohort studies.(15) In a recent Science Advisory for the American Heart Association, Harris et al (2009) reviewed the evidence of omega 6 oils and cardiovascular disease, and found agreement in the evidence from different types studies. A meta-analysis of RCTs which substituted saturated fats for omega 6 oils found a 24% decreased risk of CHD. Epidemiologically, substituting 10% of calories from saturated fat with omega 6 fats was associated with an 18mg/d decrease in LDL cholesterol. While the Nurses Health Study found women with the highest intakes of omega 6 fats (7% of energy) had a 25% reduced risk of CHD compared to those in the lowest intakes (2.8% energy).(15)

As a guide, the American Heart Association recommends up to 10% omega 6 polyunsaturated fatty acids (PUFA) and up to 1.2% omega 3 oils.(15) The rather dated UK COMA report cautiously recommends that 6.5% of total energy should come from omega 3 and omega 6 oils. Intake levels in the UK population average 5.8% of energy.(9)

Oily fish and Omega 3 oils: Evidence for the protective benefits of oily fish on CVD is abundant. Mozaffarian (2008) recently reviewed the evidence on omega 3 oils and CVD from observational studies, RCTs and experimental studies. Among the findings, a meta-analysis of over 15 cohort studies and RCTs found a 36% lower risk of CHD death in those who ate an average of 250mg per day (equivalent of 1 portion per week) compared with those who didn't eat any omega 3 fats.(12) The recommended intake amount is at least one portion of oily fish per week; UK intakes average 1/3 of a portion.(16)

Monounsaturated fats and nuts: Walnuts, peanuts and almonds are rich sources of polyunsaturated monounsaturated fats. Large-scale cohort studies have all consistently demonstrated benefits of nut consumption protecting against CHD mortality(17,18). Randomised-controlled trials (the scientific 'gold' standard) show that nut consumption lowers LDL cholesterol. Consumption of a handful of nuts a day (around 40g) reduces LDL cholesterol levels by around 4%(13,14). The effects of nut consumption reflect the dose.

Plant sterols and stanols: Plant sterols (and stanols) resemble cholesterol molecules. They lower blood cholesterol levels by competing with cholesterol in the gut. Around 90% of sterols are simply not absorbed. A recent systematic review with meta-analysis of 84 trials on the LDL cholesterol lowering effects of plant sterols and stanols found that on average consumption of 2g/d of the phytosterols was associated with 9% reduction in LDL levels. (11) Consumption of fortified yoghurts, margarines etc to meet the 2g/d target cost up to £2.50 per person per week.

Population based approaches to reducing CVD

Population based observational studies in Australia, Finland, Mauritius, Poland and the US reported substantial reductions in CHD mortality and/or mean population cholesterol levels, following the introduction of fiscal policies which reduced animal fat and increased vegetable fat consumption(19-21).

In response to extremely high CHD mortality rates, the North Karelia Project was introduced in **Finland** in 1972. Significant improvements in the population's health were observed within 5 years, and were still evident 20 years later. Dietary changes in consumption of animal fat eg use of butter on bread fell from over 80% in 1972 to around 18% in 1992(22); mean population serum cholesterol fell by 16% (1.07mmol/l) over the same time-period.(2) By 1995, CHD mortality in men had declined by 73%. Similar results were observed among women. The project undertook a variety of initiatives to bring about the observed improvements including:(2,23)

- Engaging agriculture, supermarkets and the food industry to support environmental change eg supporting dairy farmers to switch to healthier berry production; developing low fat dairy products
- Educating the public and health professionals (eg through innovative media campaigns) to encourage change and drive demand for healthier products such as low fat milk
- Engaging the local house-wives organisation to train and educate mothers in healthy cooking
- Collaboration with national authorities, and influencing national policy

Between 1990 and 1999, CHD mortality rates in **Poland** fell sharply by 26%, reversing the previous steady rises.(24) This reflected a marked reduction in saturated fat consumption of 7%, increase in polyunsaturated fat consumption of 57% and increase in PS ratio of 70%. Subsidies for dairy and meat products were cut in the late 1980s leading to price rises in animal products and butter, compounded by increased availability of cheaper rapeseed and soya bean based margarines. The resulting replacement of dietary saturated fats with polyunsaturated fats was the only marked change in CHD risk factors which convincingly explained the fall.(19,24)

In **Mauritius**, total cholesterol levels in the population fell by 0.79 mmol/l in men and 0.82 mmol/l in women between 1987 and 1992. This followed an intervention by the government in 1987, to change the composition of the commonly used cooking oil from mostly palm oil (high in saturated fatty acids) to wholly soya bean oil. Estimated intakes of saturated fats decreased by 3.5% of energy intake while intakes of polyunsaturated fats increased by 5.5%, and were mirrored in changes in serum phospholipid levels. The measured changes in

population total serum cholesterol levels reflected predictions using the Keys equations on the changes in dietary fat intakes.(20)

Norway was one of the first countries to successfully merge agriculture and health interests into effective nutrition policy which reduced chronic disease.(25) Between 1975 and 1993 dietary saturated fat consumption reduced by 18% of energy intake, leading to a reduction in blood cholesterol of 10% in the general population and halving of mortality from CHD among middle-aged men.(25,26) This followed the introduction of a Norwegian nutrition and food policy which focused on influencing production and consumption of food products. Among the interventions introduced were:(26,27)

- Subsidising production and prices of healthier foods eg more food grains, vegetables, low fat milk
- Raising prices of sugar and butter
- Regulations to promote provision of healthy foods by retailers, institutions and street vendors
- Provision of consumer food price subsidies to encourage healthier food uptake
- Education and information for professionals and the public

Action needed to replace UK population intakes of saturated fat with mono and polyunsaturated fat

European agriculture policy reform: Excess consumption of saturated fat resulting from agricultural overproduction is estimated to have contributed to 9,000 deaths from CHD each year in the EU.(28) Despite a number of reforms, the majority of the EU budget still supports the production of beef and dairy products. Much less is spent on healthier produce such as fruit, vegetables and food grains. CAP therefore needs to be radically reformed to encourage and support farmers to switch production from animal fat to healthy foods.

Banning trans fats: Several countries including Denmark and Switzerland and US cities have taken steps to ban and/or label trans fats in food.(9) Some UK food manufacturers have removed trans fats from their own products. However, value supermarkets that sell imported products are currently not covered by any active UK trans fat reduction policies. UK action on trans fats including mandatory labelling by FSA and SACN is overdue.

The **Scientific Advisory Committee on Nutrition** urgently needs to undertake a revision of the dated 1991 COMA dietary reference values for the UK population. Revision of the recommendations on saturated fats is long overdue, and these targets should also be extended to children over two as is the case in other countries such as the US and Finland. SACN undertook a rapid review of trans fats in the UK in 2007 but failed to recommend a UK ban on trans fats, owing to reported action by the UK food industry(8). However, the growing sector of imported value foods is not covered, and SACN should reconsider action on trans fat in light of this.

The **Food Standards Agency** (FSA) is working with industry on voluntary product reformulation, reducing portion sizes, and increasing availability of healthier options. It has also launched a national saturated fat campaign to raise consumer awareness. However, further actions by FSA should include:

- Setting targets for saturated fat reductions by food industry, as they have successfully done with salt
- Setting promotional targets for supermarkets which reflect the recommended proportions of the Eatwell plate(29).

Food manufacturers & retailers: need to undertake further reformulation of mainstream products, stock healthier alternatives, adopt responsible in-store promotions which reflect the Eatwell plate proportions,(29) and universally adopt the traffic light labelling scheme.

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