

HEART OF MERSEY BRIEFING PAPER:  
GOOD FATS: BAD FATS



## SUMMARY

**Blood cholesterol and coronary heart disease:** Our bodies produce two types of cholesterol, which are distinguished by the proteins which carry them in the blood. Low density lipoproteins (LDL) transport cholesterol from the liver to the rest of the body through the arteries. When 'bad' LDL cholesterol levels in the blood are high, the cholesterol sticks to the artery walls resulting in plaques (atherosclerosis) leading to heart attacks and strokes. High density lipoproteins (HDL) transport cholesterol from the blood to the liver, which then prepares the cholesterol for clearance from the body. HDL cholesterol is 'good' cholesterol.

**Saturated and trans fats:** Blood cholesterol levels are powerfully influenced by dietary fat intake. Dietary saturated fats increase levels of 'bad' LDL cholesterol. The main sources of saturated fats are butter, full fat dairy products, processed foods, meat and meat products. Saturated fat intakes in the UK population are much too high. Trans fats are artificially made saturated fats by the process of hydrogenation, although some trans fats occur naturally in ruminant products, for example, milk and cheese. Intake levels in the UK are below the maximum limits of 2% of energy from food but should not increase.

**Polyunsaturated and monounsaturated fats:** reduce 'bad' LDL cholesterol and raise 'good' HDL cholesterol. These are found in vegetables, nuts, avocados and vegetable oils including olive oil, rapeseed and sunflower oil.

**Plant sterols** (and stanols) substantially lower LDL cholesterol levels in the blood. Clinical trials have shown that daily consumption of 3g of plant sterols reduces risk of CHD by 25% in adults. Fortified margarines (e.g. Benecol, Flora Pro-Activ) and yogurts (e.g. Danacol, Benecol) help meet the 3g per day dietary sterol recommendation for adults.

**Oily fish and omega 3 oils:** oily fish are a rich dietary source of omega 3 oils. These powerfully protect against CHD through a number of mechanisms including reducing plaque formation and inflammation, regulating heart beat and lowering blood pressure. The Food Standards Agency (FSA) recommends that everyone in the population should eat at least two portions of oily fish per week. Oily fish include herring, mackerel, salmon, trout and fresh tuna. Plant sources include: flaxseeds, soya beans, walnuts and their oils.

**Population based approaches to reducing CHD:** Switching from animal based saturated fat sources to plant based mono and polyunsaturated fat sources has been shown to be protective against CHD in several populations. Population based observational studies in Australia, Finland, Poland, Mauritius and the US have shown significant reductions in CHD mortality following the introduction of fiscal policies which resulted in a reduction in animal fat and an increase in vegetable fat availability.

**Action needed:** Heart of Mersey is working to support actions which will reduce the population's intakes of saturated fat through its Food and Health Strategy for Greater Merseyside. The Common Agricultural Policy (CAP) needs to be reformed to stop subsidising the over-production of animal fat (beef and dairy), and instead encourage the production of foods which support health such as fruit and vegetables. The food industry needs to systematically reformulate products to reduce the large amounts of saturated fat which are hidden in processed foods. All food providers need to substantially reduce the saturated fat content of foods they serve, replacing these with unsaturated fats. They can do this by: using polyunsaturated fats in cooking; using skimmed milk in cooking and drinks; using lower fat cheeses; offering healthier snack alternatives such as nuts or chopped fruit and vegetables instead of cakes, crisps or biscuits; and incorporating more foods of vegetable origin, for example, nuts, beans, pasta, rice, couscous into main dishes. Individuals can do the same in the home.

Coronary Heart Disease (CHD) has a wide range of potentially reversible biological characteristics that have been identified as risk factors. It is likely that these risk factors interact with each other. Diet, smoking and physical inactivity all contribute to CHD. The role of dietary fat and its effect on plasma cholesterol is crucial in preventing CHD but other dietary characteristics need to be recognised – plenty of fruit and vegetables and whole grain cereals are needed to complement a low fat/modified fat diet.

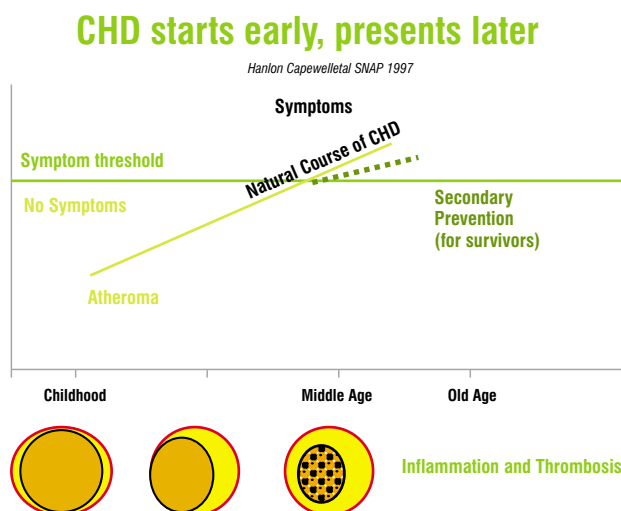
## Blood Cholesterol and Coronary Heart Disease

Our livers produce cholesterol, a wax-like fat. Cholesterol levels are powerfully influenced by the types and amounts of food we eat. Cholesterol is used in the formation of cell membranes, some hormones and in the production of vitamin D in our bodies.

However, excessive amounts of cholesterol in the blood cause problems. High cholesterol levels are prone to oxidation. Oxidised cholesterol gets deposited on the walls of the arteries. In response, the body's immune system attacks the cholesterol deposits in an effort to remove them. This results in the formation of scar and fatty tissue on the artery walls, known as plaques. The plaques build up over the years, leading to narrowing of the arteries and the development of coronary heart disease, strokes and peripheral vascular disease. Worrying studies of children and young people killed in road traffic accidents have shown that the atheroma process begins in childhood and worsens with age and poor diet<sup>1</sup> (see Figure 1).

Some individuals with CHD experience pain in the chest (angina) which alerts them to the fact that they have the disease, enabling them to seek treatment. However, for many people, the first symptom of CHD is a heart attack. This happens when an artery becomes completely blocked, stopping blood from flowing to the heart. Around half of all heart attacks are fatal (see Figure 1).

**Figure 1: The natural progression of coronary heart disease**



Source: Professor Simon Capewell, The University of Liverpool.

## Types of cholesterol

Cholesterol is transported on carrier proteins in the blood. There are two main types of cholesterol carriers:

- “Bad” low density lipoproteins (LDL) transport cholesterol from the liver through the arteries to the rest of the body. When LDL levels in the blood are high, the cholesterol sticks to the artery walls, resulting in plaques (atherosclerosis).
- “Good” high density lipoproteins (HDL) transport cholesterol from the blood to the liver, which then removes the cholesterol from the body. High levels of HDL eliminate cholesterol from the blood, and reduce the risk of plaque formation. Smoking interferes with HDL metabolism.
- HDL cholesterol is positively affected by lifestyle (physical activity, moderate alcohol consumption, consumption of plant sterols/stanols, not smoking).

**Table 1: Effects of different types of fats on cholesterol levels**

Type of fat	Dietary sources	Effect on bad LDL cholesterol	Effect on good HDL cholesterol
<b>Bad fats</b> (generally solid at room temperature)			
Saturated fat	Butter, milk, cheese, dairy products, beef, lamb, other red meat, poultry fat & skin, biscuits, savoury snacks, fried foods, processed foods.	Raise	Trivial
Trans fat	Processed foods including cakes, pastries, crisps, take-away foods, hard margarines, fried foods.	Raise	Trivial
<b>Good fats</b> (generally liquid at room temperature)			
Plant sterols and stanols	Fortified soft margarines and yoghurts eg Benecol, Danacol and Flora Pro-Activ; fruits and vegetables, nuts, seeds, cereals.	Substantially lower	Raise
Polyunsaturated fat	Sunflower, corn oil, soya bean oil.	Lower	Raise
Mono unsaturated fat	Olive oil, nuts, avocado.	A bit lower	Raise
Oily fish and omega 3 oils Other benefits are mediated through mechanisms other than cholesterol	Oily fish: mackerel, sardines, herring, rainbow trout, fresh tuna. Plants: flaxseeds, soya beans, walnuts and their oils; green leafy vegetables.	Lower	Raise

Adapted from: Fats & Cholesterol: Nutrition Source, Harvard School of Public Health<sup>2</sup>

## Saturated fats: the major problem

Saturated fats are produced by all mammals including humans, cows, pigs, sheep, goats etc. They are deposited around internal organs such as the heart and lungs to protect them. Saturated fats are also used in the formation of cell membranes, the production of cholesterol and cholesterol-related hormones. They are deposited under the skin, where they form an insulating layer which keeps mammals warm. However, saturated fats are not essential to the human diet, as they can be made by the body.

When humans consume excessive amounts of saturated fats these raise LDL (and HDL) cholesterol levels, with a negative effect on health. Saturated fats are the principal cause of elevated LDL levels in Western diets. The main sources are butter, cheese, full fat yogurts, red meat, processed foods, cakes, pastry, biscuits, pizza, sausages and pies.

### *Intake levels in the UK*

Saturated fats are a significant public health concern in the UK. The target intake level for the UK population is 10% of food energy, but the ideal level for optimum health is around 5% of food energy. Intake levels are considerably higher than the ideal 5% of food energy intake in all population groups:

- Average intake levels for children (aged 2-18) are around 14.3% of food energy.<sup>3</sup>  
In other words, saturated fat intakes among children are over two fold higher than ideal levels
- Average intake levels for adults are around 32g, the equivalent of 13.4% of food energy.<sup>4</sup>  
This means that saturated fat intakes among adults are likewise over twice the ideal.

### *Situation in the US*

- Mean intake of saturated fat is 28g per person or 11.6% of total energy intake
- The US dietary guidelines were revised in 2005 and have a strong focus on limiting saturated fat intake to less than 10% of total energy intake from food. They recommend that most fats should come from sources of polyunsaturated and monounsaturated fatty acids, such as fish, nuts, and vegetable oils
- The guidelines recommend fat free or lower fat milk and alternative products from age two.<sup>5</sup>

## Trans fats: also harmful

Trans fats raise the 'bad' LDL cholesterol and lower the 'good' HDL cholesterol, and therefore have a detrimental effect on health.

They are made through the process of 'hydrogenation' where hydrogen is added to unsaturated fats to make them hard, and occur naturally through the rumination process, for example in cows. Trans fats are used by the food industry because they enhance flavours and are more stable than saturated fats, giving products a longer shelf life. Trans fats occur naturally in small amounts in animal sources of food such as meat and poultry. However, the majority of dietary trans fat – over 80% comes from processed foods including hard margarines, cakes, biscuits, pastries, take-aways and fried food.<sup>5</sup>

### *Intake levels in the UK*

Recent changes in manufacturing processes due to concerns over the implication of high trans fats have led to a reduction in the amount of trans fats in the diet. Unlike saturated fats, trans fats are less of a public health problem in the UK as intake levels are below the maximum recommended level of 2% of total energy:

- Intake levels for adults are 1.2% of energy<sup>4</sup>
- Intake levels in children are 1.4% for boys and 1.5% for girls.<sup>3</sup>

### *The situation in the US*

At around 2.6% of energy, intake levels of trans fats in the US are nearly double those in the UK. Trans fats are a public health problem in the US. Fast foods, snacks and processed foods are largely responsible for the high intake levels in the US.<sup>6</sup> The US government has introduced legislation which will make it compulsory for the trans fat content of foods to be included on food labels from 2006.

### *European Food Safety Authority's position on trans fats*

In 2004, the European Food Safety Authority's (EFSA) Scientific Panel on Dietetic Products, Nutrition and Allergies published a position paper reviewing the scientific evidence around trans fats in the region. EFSA concluded that "at equivalent dietary levels, the effect of trans fatty acids on heart health may be greater than that of saturated fatty acids. However, current intakes of trans fatty acids are generally more than 10 fold lower than those of saturated fatty acids." In many European countries intakes of saturated fatty acids exceed dietary recommendations, and therefore saturated fats represent a much greater public health risk than trans fats.<sup>7</sup>

## **The Good Fats**

The different types of good fats and their contributions to health are outlined below. These should replace saturated fats in the diet.

### **Poloyunsaturated oils**

#### *Omega 6 oils*

Plant based omega 6 oils have been shown to be highly protective against CHD. Linoleic acid is the principal omega 6 oil which supports health. It does this by reducing the levels of total and LDL cholesterol. A large body of evidence supports the health impact of linoleic acid including meta analyses of clinical trials, and long-term prospective cohort studies such as the nurses' health study in the US.<sup>8,9,10</sup>

**Dietary sources** of omega 6 oils include seeds and oils from the following plants: pumpkin, sunflower, corn, soya and wheatgerm. Vegetables, fruits, nuts and grains are also good sources.

#### *Plant sterols and stanols*

Plant sterols (and stanols) are found in the cell membranes of plants. They are of a similar structure to animal cholesterol and lower cholesterol levels in the blood by competing for receptors on the 'packages' which transport cholesterol from the gut into the blood. Around 90% of sterols are simply not absorbed from the gut. By increasing consumption of sterols up to 3g per day, LDL cholesterol levels greatly reduce. Clinical trials and observational studies have shown that daily consumption of 3g of plant sterols lowers cholesterol levels by 10%-30% and reduces risk of CHD by 25%-50% in adults.<sup>11</sup>

A normal diet provides around 0.25g of plant sterols, and a vegetarian diet around 0.5g. In order to reach the 3g level per day, adults therefore need to consume fortified products. Fat based products such as margarines are most suitable. In the UK Flora Pro-Activ and Benecol are two margarines which are fortified with around 3g of plant sterols and/or stanols per portion. A range of other products including milk and yogurts are also available.

Consumption of margarines with added sterols or stanols cost around £1.30 per person per week. In patients with CHD they provide an additive effect to that of LDL cholesterol reduction with statins. Statins lower cholesterol levels more than fortified margarines but cost three times as much and have various side effects.<sup>11</sup>

## Oily fish and Omega 3 oils

Oily fish and some plant based foods are rich dietary sources of omega 3 polyunsaturated fatty acids (omega 3 oils). These have a number of important health benefits including:

- Development of the central nervous system including brain and vision in the infant during pregnancy and lactation. Studies have shown infants with higher intake levels of fish oils have better vision at three years.<sup>12</sup>
- Protecting against CHD through a number of mechanisms including reducing plaque formation and inflammation, regulating heart beat and lowering blood pressure.<sup>12</sup>

Evidence for the protective benefits of fish for cardiovascular disease is abundant. Prospective cohort studies have shown that those who consume fish have a much lower CHD risk than those who don't. The bigger the dose, the larger the benefit. Clinical trials have demonstrated improvement in CVD risk and blood lipid profile from consumption of omega 3 oils. In high risk patients, the benefits from increasing fish consumption can occur within two months.<sup>13</sup>

### *Recommended intake levels for fish*

The Scientific Advisory Committee on Nutrition (SACN) recently reviewed the available evidence on fish consumption and published advice in 2004.<sup>12</sup> Current consumption levels in the population average only about one third of a portion of oily fish per week. The Food Standards Agency recommends that everyone in the population should eat **at least two portions** of fish per week, one of which should be oily.

The limits for which the population can safely consume oily fish are as follows:

- Men, boys and women past childbearing age, or those who won't be having children can eat **up to four portions** of oily fish per week
- Girls and women who might become pregnant at some point in their lives can eat **up to two portions** of oily fish a week
- There are no limits for white fish.



### *Toxins in fish*

Exceeding the recommendations above over a short period, for example, over a few months, is not harmful. In a small proportion of sensitive individuals, exceeding the recommended intake levels over a prolonged period could be harmful. *[Dioxins and dioxin-like PCBs (polychlorinated biphenyls) are fat soluble chemicals which are present in marine environments due to pollution. These can accumulate in the fat in oily fish, and excessive intakes may be harmful in a small proportion of susceptible individuals in the population].*<sup>12</sup>

**Oily fish include:** salmon, trout, mackerel, herring, sardines, pilchards, kipper, anchovies and fresh tuna (the process of canning tuna eliminates the fat content).

**Plant based sources:** omega 3 oils are found in flaxseeds, soya beans, walnuts and their oils. Green leafy vegetables including brussel sprouts, spinach and kale are also good sources. Salad dressings made from non-hydrogenated soya bean oil are also good sources of these omega 3 oils.<sup>8</sup>

### **Monounsaturated fats**

Monounsaturated fats in the diet lower LDL cholesterol levels, reducing risk of CHD. There is good evidence to show that populations eating diets rich in monounsaturated fats, for example, the Mediterranean diet, have lower levels of CHD. Rich sources of monounsaturated fats include olive oil, avocados and nuts.

### *Nuts*

Nuts including walnuts, peanuts and almonds are rich sources of polyunsaturated monounsaturated fats, as well as other protective substances. Large-scale cohort studies including the Seventh-Day Adventists Study and Physicians Study have all demonstrated benefits of nut consumption protecting against CHD mortality.<sup>14,15</sup> Randomised controlled trials (RCTs) are considered the gold standard when it comes to providing evidence of causality. RCTs show that nut consumption lowers LDL cholesterol. Consumption of a handful of nuts a day (around 37g) reduces LDL cholesterol levels by around 4%.<sup>16,17</sup> The effects of nut consumption reflect the dose. Due to their high calorie content, nuts should not be consumed in excessive amounts.

Other mechanisms by which nuts protect against CHD: they are high in arginine – a substance which is a precursor for Nitric Oxide, which relaxes the artery walls and allows blood to flow more freely, reducing the risk of developing atherosclerosis. Nitric Oxide also makes the blood less 'sticky' thereby helping to reduce the formation of plaques in the artery walls.<sup>18</sup> *[Note: macademia nuts are harmful, containing mostly saturated fats].*

## Obesity

Obesity levels in the UK have been rising at alarming rates. All fats are high in calories and excess consumption of dietary fats can significantly contribute to obesity. The optimum diet should contain no more than 25% to 35% of energy from total fat. This should predominately consist of poly and monounsaturated fats. As previously stated, the UK population is currently exceeding the maximum recommended intakes of 'bad' saturated fats. The key population goal should therefore be to replace saturated fats in the diet with poly and monounsaturated fats. Options for making this possible at a population and individual level are outlined below.

## Population based approaches to reducing CHD

Switching from animal based saturated fat sources to plant based polyunsaturated fat sources has been shown to be protective against CHD in several populations. Population based observational studies in Australia, Finland, Mauritius, Poland and the US have shown significant reductions in CHD mortality following the introduction of fiscal policies which subsequently resulted in a reduction in animal fat and increase in vegetable fat availability. In Poland for example, mortality rates from CHD in the early 90s bucked the year-on-year steady rise and fell sharply by 26%.<sup>19</sup>

This coincided with marked reductions in butter consumption and sharp increases in polyunsaturated margarine and vegetable cooking oil consumption. Subsidies for dairy and meat products were cut in the late 80s leading to higher prices and a rise in the development and availability of cheaper rapeseed and soya bean based margarines on the market. The resulting replacement of dietary saturated fats with polyunsaturated fats was the only marked change in CHD risk factors which explained this observation.<sup>19, 20</sup>

## Actions needed to replace dietary saturated fat with mono and polyunsaturated fat

Heart of Mersey is working to support these actions which will reduce the population's intake of saturated fat through its Food and Health Strategy for Greater Merseyside.

## Policy makers & Food producers

The Common Agricultural Policy (CAP) was originally put in place in the postwar years to prevent food shortages from ever happening again in Europe. It has persisted for many decades and still supports the over-production of beef and dairy products through its subsidy system.

As a result the price of these commodities has been kept artificially low. Vast amounts of cheap saturated fat is thus available to add to processed foods to improve texture, flavour and add bulk to products such as sausages, biscuits, burgers, pies, cakes, pastries, pizzas and cheese.

This has resulted in the UK and European populations consuming huge amounts of animal fat, much of which is hidden in processed foods. The CAP needs to be radically reformed to stop subsidising the over-production of animal fat, and instead support the production of foods which support health such as fruit and vegetables. The food industry needs encouragement or, if necessary, legislation to reformulate its products to reduce the large amounts of harmful saturated fat in the food chain.

Other European policies such as the provision of subsidies for the disposal of full fat milk in schools and hospitals also need to be updated and be refocused on skimmed milk.

## Retailers

Retailers should help by stocking healthier alternatives to products which are high in saturated fats, for example, unsaturated cooking oils, low fat dairy products, fish, lean meats, nuts and seeds, pulses, fruit and vegetables. Promotions and price offers should also be geared towards foods which are low in saturated fat. Retailers providing consumers information on cooking methods should ensure that these are healthier methods.

## Food providers and individuals

All food providers and individuals need to greatly reduce the saturated fat content of foods they prepare, replacing these with unsaturated fats. Food providers include the food service sector in schools, hospitals, workplace canteens, restaurants, pubs etc.

*Simple tips to switching to healthier fats:*

- Replace meat and incorporate more foods of vegetable origin into main dishes e.g. nut, pulses, beans
- Eat fish instead of meat, especially oily fish e.g. sardines, mackerel, trout
- Choose non-dairy sources of calcium e.g. tofu, sardines with bones, kale, soya beans, sesame seeds, tahini (sesame seed paste), almonds, dried apricots, hummus
- Choose lean meat, remove skin and visible fat from meat and poultry
- Switch to skimmed milk and lower fat dairy products such as yoghurt and cheese
- Use fat free cooking methods or small amounts of unsaturated fats in cooking e.g. olive or sunflower oil
- Replace cakes, biscuits, crisps and other unhealthy snacks with nuts and dried or chopped fruit and vegetables
- Cut down on processed foods and choose foods which are low in saturated fat on the labels
- Add or sprinkle seeds (e.g. sunflower, pumpkin or sesame) to salads, soups, smoothies, breakfast cereals and bread
- Use salad dressings that are based on unsaturated oils e.g. olive and soya oils
- Avoid mayonnaise or use low fat varieties
- Choose foods containing plant sterols or stanols e.g. fortified soft margarines and yoghurts like Benecol, Danacol and Flora Pro-Activ.

## Resources on healthier eating and practical tips on switching to healthier fats:

- The DASH eating plan: [www.nhlbi.nih.gov/health/public/heart/hbp/dash/index.htm](http://www.nhlbi.nih.gov/health/public/heart/hbp/dash/index.htm)
- Section A: *Healthy Eating* in Nutrition and Food Poverty: A toolkit to support the development and implementation of nutrition and food poverty strategies. [www.heartforum.org.uk](http://www.heartforum.org.uk)
- *Food Facts* from the British Dietetic Association – [www.bda.uk.com](http://www.bda.uk.com)
- The Food Standards Agency, healthy eating website: [www.eatwell.gov.uk](http://www.eatwell.gov.uk)

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## References

1. Berenson GS, Srinivasan SR, Bao W, Newman WP 3rd, Tracy RE, Wattigney WA, 1998. Association between multiple cardiovascular risk factors and atherosclerosis in children and young adults. The Bogalusa Heart Study. *New England Journal of Medicine*; 338:1650-6.
2. Harvard School of Public Health 2004. *Fats & Cholesterol: Nutrition Source*.
3. Gregory J and Lowe S. 2000. *National Diet & Nutrition Survey: Young people aged 4 to 18 years*. London: TSO.
4. Henderson L, Gregory J, Irving K and Swan G. 2003. *The National Diet & Nutrition Survey: adults aged 19 to 64 years. Volume 2: Energy, protein, carbohydrate, fat*. London: TSO.
5. Department of Health and Human Services and Department of Agriculture, US. *Dietary Guidelines for Americans 2005*. Last accessed at: [www.healthierus.gov/dietaryguidelines](http://www.healthierus.gov/dietaryguidelines)
6. Bialostosky K, et al. 2002. *Dietary intake of macronutrients micronutrients and other dietary constituents: United States 1988-94*. National Center for Health Statistics. Vital Health Stat 11(245).
7. EFSA. 2004. *Opinion of the Scientific Panel on Dietetic Products, Nutrition and Allergies on a request from the Commission related to the presence of trans fatty acids in foods and the effect on human health of the consumption of trans fatty acids*. Request N° EFSA-Q-2003-022. Adopted on 8 July 2004.
8. Hu F, Manson , Willet W 2001. Types of dietary fat and risk of coronary heart disease: A critical review. *JAMA* 20, 1: 5-19.
9. Wijendran V and Hayes K 2004. Dietary N-6 and n-3 fatty acid balance and cardiovascular health. *Annual Reviews in Nutrition*. 24: 597-615.
10. Schaefer EJ 2000. Lipoproteins, nutrition and heart disease. Special article. *Am. Journal of Clinical Nutrition*. 75: 191-212.
11. Law M 2000. Plant sterol and stanol margarines and health. *BMJ* 320:861-4.
12. SACN 2004. *Advice on fish consumption: Benefits & risks*. London: TSO.
13. He K, Song Y, Daviglius M, Liu K et al 2004. Accumulated evidence on fish consumption and coronary heart disease mortality. A meta-analysis on cohort studies. *Circulation* 109: 2705-11.
14. Albert CM, Gaziano M, Willett, W, Manson J 2002. Nut consumption and decreased risk of sudden cardiac death in the Physicians' Health Study. *Archives of Internal medicine* 162: 1382-7.
15. Hu F, Stampfer M, Manson J, Rimm E et al 1998. Frequent nut consumption and risk of coronary heart disease in women: prospective cohort study. *BMJ* 317: 1341-5.
16. Jenkins DJ, Kendall CW, Marchie A, Parker T et al 2002. Dose response of almonds on coronary heart disease risk factors: Blood lipids, oxidized low-density lipoproteins, lipoprotein(a), homocysteine, and pulmonary nitric oxide. A randomized, controlled, crossover trial. *Circulation*; 106:1327-1332.
17. Sabate J, Haddad E, Tanzman J, Jambazian P and Rajaram S. 2003. Serum lipid response to the graduated enrichment of a Step 1 diet with almonds: a randomized feeding trial. *American Journal of Clinical Nutrition*. 77: 1379 -84.
18. Hu F 2003. Plant based foods and prevention of cardiovascular disease: an overview. *American Journal of Clinical Nutrition*: 78 (suppl): 544S -51S.
19. Zatonski A and Willet W 2005. Changes in dietary fat and declining coronary heart disease in Poland: population based study. *BMJ* 331: 187-88.
20. Zatonski A, McMicael A and Powles J 1998. Ecological study of reasons for sharp decline in mortality from ischaemic heart disease in Poland since 1991. *BMJ* 316: 1047-51.



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