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Trans-fatty acids and Heart Disease

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On at least seven occasions, this column has discussed trans-fatty acids and the danger they represent to the body. Following the series on the Mediterranean health diet, trans-fatty acids are revisited because of the harm they do to your body and how common they are in the food chain in the United States of America.

On November 12, 1999, the Food and Drug Administration announced its proposal to include the *trans*-fatty acid (*trans* fat) content of foods on the standard food label. Many persons are unfamiliar with *trans* fat and its health effects which proves once again, "Only what you don't know can hurt you."

What are *trans* fatty acids?

Trans unsaturated fatty acids, or *trans* fats, are solid fats produced artificially by heating liquid vegetable oils in the presence of metal catalysts and hydrogen. This process also called "partial hydrogenation", causes carbon atoms to bond in a straight configuration and remain in a solid state at room temperature. Naturally-occurring unsaturated fatty acids have carbon atoms that line up in a bent shape, resulting in a liquid state at room temperature.

Which foods contain *trans* fatty acids?

Trans fats are produced commercially in large quantities to harden vegetable oils into shortening and margarine. Food manufacturers also use partial hydrogenation of vegetable oil to destroy some fatty acids, such as linolenic and linoleic acid, which tend to oxidize, causing fat to become rancid with time. The oils used to cook french fries and other fast food are usually this kind of partially hydrogenated oil, containing *trans* fats. Commercial baked goods frequently include *trans* fats to protect against spoilage. A small amount of *trans* fat is also produced in the gastrointestinal tract of cattle, so that low levels of these isomers are found in dairy and beef fat.

Commercial production of partially hydrogenated fats began in the early 20th century and increased steadily until about the 1960s as processed vegetable fats displaced animal fats in the diets of the U.S. and other Western countries. Lower cost was the initial motivation, but health benefits were later claimed for margarine as a replacement for butter.

Although the average level of *trans* fat in margarines has declined with the advent of softer versions, per capita consumption of *trans* fatty acids has not changed greatly since the 1960s because of the increased use in commercially-baked products and fast foods.

What are the health effects of *trans* fats?

Concerns have been raised for several decades that consumption of *trans* fatty acids might have contributed to the 20th century epidemic of coronary heart disease. Metabolic studies have shown that *trans* fats have adverse effects on blood lipid levels:

- increasing LDL (bad) cholesterol
- decreasing HDL (good) cholesterol.

This combined effect on the ratio of LDL to HDL cholesterol is double that of saturated fatty acids. *Trans* fats have also been associated with an increased risk of coronary heart disease in epidemiologic studies. In a report from ten years ago, it is estimated that approximately 30,000 premature coronary heart disease deaths annually could be attributable to consumption of *trans* fatty acids.

What are the arguments for listing *trans* fat separately from saturated fat?

The combined results of metabolic and epidemiologic studies strongly support an adverse effect of *trans* fat on risk of CHD. Furthermore, two independent methods of estimation indicate that the adverse effect of *trans* fat is stronger than that of saturated fat. By our most conservative estimate, replacement of partially hydrogenated fat in the U.S. diet with natural unhydrogenated vegetable oils would prevent approximately 30,000 premature coronary deaths per year, and epidemiologic evidence suggests this number is closer to 100,000 premature deaths annually. These reductions are higher than what could be achieved with realistic reductions in saturated fat intake.

What alternatives exist to *trans* fats?

In Europe, producers have responded rapidly to the evidence on effects of *trans* fats by developing *trans*-free margarines that are also low in saturated fats. More recently, these products have also become available in the U.S., although a large share of the market is still heavily hydrogenated stick margarine.

It is thus evident that *trans*-free products are feasible, and that the technical constraints often invoked by the food industry can be overcome. However, out of the *trans* fatty acids provided by hydrogenated vegetable oil in the U.S., only 25% to 37% comes from margarines, the remainder comes from:

- baked goods,
- fast foods

- other prepared foods.

Replacement of *trans* in such products by healthier fats may be more difficult than in margarines, but can be achieved.

In spite of this, many products including most baked goods and fried fast foods still are made with partially hydrogenated fat both in Europe and in the U.S. and are high in *trans* fatty acids. It is unlikely that this situation will change without strong federal regulations.

How important are label changes?

Although changes in labeling are extremely important, many products, including fast food, which often contain extremely high levels of *trans* isomers, are exempt from labeling regulations and can carry deceptive labels such as "cholesterol-free" and "cooked in vegetable oil."

For example, a person eating one doughnut for breakfast (3.2 g) and a large order of french fries for lunch (6.8 g) would ingest 10 g of *trans* fatty acids, or 5 percent of the total energy of a 1,800-calorie diet. Thus, simple labeling changes alone will not be sufficient.

Effects on blood cholesterol

In 1990, attention was given to the fact that although *trans* fatty acids increase LDL cholesterol to a similar degree as saturated fat, they decrease HDL cholesterol. A rigorous metabolic study demonstrated that replacement of 10% of energy from oleic acid (the primary monounsaturated fat in diets) with *trans* fatty acids caused an increase in LDL cholesterol and a decrease in HDL cholesterol; whereas replacement of oleic acid with saturated fat caused a similar increase in LDL cholesterol, but virtually no change in HDL cholesterol. As a result, the LDL/HDL cholesterol ratio was significantly higher on the *trans* fat than on the saturated fat or oleic diets. These findings were soon confirmed in several investigations.

The probability that these results were due to chance is vanishingly low; taken together, these studies provide definitive evidence that *trans* fats raise the LDL/HDL ratio more than saturated fats. Moreover, these effects of *trans* fat on the LDL/HDL cholesterol ratio are remarkably constant across studies.

These results confirm the deleterious effects of *trans* fat on blood lipids and indicate that these may offset the beneficial effects of polyunsaturated fat. Thus individuals who are replacing butter with margarine high in *trans* fat to reduce their risks of coronary disease may obtain no benefit or -- if *trans* fat has deleterious effects beyond those on LDL and HDL -- may even increase their risk.

In addition to increasing the LDL/HDL cholesterol ratio, *trans* fatty acids increase Lp(a) -- referred to as "Lp little a" -- when substituted for saturated fat. Most of the public is

unfamiliar with Lp(a) but it is a highly atherogenic lipid particle which is not often tested. It is found in family groups and where found must be treated. A significant increase of Lp(a) caused by *trans* fats was reported in nine of ten trials. High blood levels of Lp(a) have been associated with increased risk of CHD, independently of LDL or HDL cholesterol concentrations. However diet-induced variations in blood concentrations of Lp(a) are modest relative to the genetic differences.

Yet another effect of *trans* fatty acids on blood lipids is that on fasting triglyceride levels. The use of hydrogenated corn oil results in higher triglyceride levels than natural oils or butter. A triglyceride-raising effect was also consistently seen in seven recent studies that directly compared *trans* fatty acids with unsaturated fatty acids. Thus, *trans* fatty acids increase triglyceride levels when compared with other fatty acids. Eliminating 2% of energy *trans* fatty acid from the diet would lower triglyceride levels.

Epidemiological studies

In a study in the Boston area, a strong and significant positive association between *trans* fat intake and risk of acute myocardial infarction was found.

The strongest epidemiological evidence relating dietary factors to risk of CHD is provided by prospective investigations. The relation between *trans* fatty acids intake and risk of coronary disease has now been reported from three large, the *Health Professionals Follow-up Study* (HPFS), the *Alpha-Tocopherol Beta-Carotene* study (ATBC) and the *Nurses Health Study* (NHS). In these studies, *trans* fat consumption was assessed. In addition, the relation between margarine intake and risk of CHD has been reported from the Framingham Study. The results of each of these investigations support an adverse effect of *trans* fatty acids.

High consumption of *trans* (or margarine) was not related to other dietary behaviors perceived as healthy for the heart, such as a preference for skim rather than whole milk and high-*trans* foods that are hardly perceived as healthy, such as cookies, were also positively associated with risk of CHD in the Nurses Health Study. Thus there appear to be no likely alternative to the hypothesis that high *trans* intake increases the risk of CHD.

Conclusion

Five years ago evidence was strong that *trans* fat had deleterious impacts on blood lipids; ensuing studies have confirmed these metabolic findings and strengthened epidemiologic support for an important adverse effect on risk of coronary heart disease. These data highlight the need for rapid implementation of labeling requirements that include fast foods. Because partially hydrogenated fats can be eliminated from the food supply by changes in processing that do not require major efforts in education and behavioral modification, these changes would be an extremely efficient and rapid method for substantially reducing rates of coronary disease.

Do your heart a favor – it deserves a break today – avoid fast foods, processed foods and ANY food where the label says there are *trans* fats. Your heart will thank you. Remember, it is your life and it is your health.