LIPIDS AND LIFESTYLE

What are lipids?

Cholesterol is a fat-like substance used to help build cell membranes, make some hormones, synthesize vitamin D, and form bile secretions that aid in digestion. Since fat can't mix with water, which is the main ingredient of blood, cholesterol's most important job is to help carry fat through your blood vessels. Before cholesterol can enter the bloodstream it is coated with a protein. These cholesterol-protein packages are referred to as lipoproteins.

Lipoproteins are transport vehicles in the circulation plasma that are composed of various lipids such as cholesterol, phospholipids, triglycerides and proteins known as apoproteins. The major classes of lipoproteins are chylomicrons, very low-density lipoprotein cholesterol (VLDL-C), LDL-C, and HDL-C. Chylomicrons are the largest lipoproteins, consisting of approximately 85% triglycerides. Triglycerides are the main type of lipids found in adipose tissue and in the diet. Once the triglycerides are removed from the chylomicron at receptor sites in the body, the chylomicron remnant is returned to the liver for further metabolism. The principal lipid of VLDL-C is also triglycerides (60 - 70%).

LDL-C is the primary transport carrier of cholesterol in the circulation. About 50-60% of cholesterol is delivered to the cells by LDL-C. Evidence suggests that LDL-C may directly contribute to the cellular alterations of the inner walls of arteries which may ultimately lead to the development of atherosclerotic plaque (Scann, 1978) . Thus, LDL-C is proposed to be more highly associated with Coronary Heart Disease (CHD) than total cholesterol (Manson et al., 1992) .

On the other hand, HDL-C has an inverse relationship with coronary heart disease, offering a protecting mechanism against the development of CHD (Kannel, Castelli, & Gordon, 1971) . HDL-C is considered to be the most powerful lipid parameter for predicting CHD in people of all ages (Gordon et al., 1977) . The primary function of HDL-C is to transport cholesterol from the tissues and blood to the liver for excretion from the body or synthesis into bile acids. HDL-C also prevents the uptake of LDL-C at receptor sites in the body and participates in the metabolism of other lipoproteins.

HDL-C is predominantly composed of phospholipids and is separated into several subclasses, based on size and particle density. The major subclasses are referred to as HDL2 and HDL3. It is known that females have a higher content of HDL2 than males, which helps to protect women from developing CHD (Wood & Haskell, 1979) .

Why are lipid levels important?

The association between high serum cholesterol levels and the incidence and severity of coronary heart disease (CHD) is so pronounced in epidemiological studies that the National Heart, Lung, and Blood Institute recognizes this association as causal (Expert Panel, 1993) . Recent overviews have indicated that a 1% reduction in a person's total serum cholesterol level yields a 2 to 3% reduction in the risk of coronary heart disease (Manson et al., 1992).

Dr C A Speed BMedSci MA Dip Sports Med PhD FRCP FFSEM
Consultant Rheumatology, Sports & Exercise Medicine
01223 306073

Exercise and your lipids

Aerobic fitness and exercise programs such as walking, jogging, and aerobics have been encouraged as a means to reduce total cholesterol, low-density lipoprotein cholesterol (LDL-C), and triglycerides while elevating the "good" high-density lipoprotein cholesterol (HDL-C). Several long-term, or longitudinal, studies have been conducted with healthy individuals to measure the effect of increased physical activity on serum lipoprotein concentrations. The results of these studies have been mixed.

There is a variety of environmental and personal factors that may influence a person's cholesterol composition such as age, gender, level of body fat, dietary intake of fat, cholesterol and carbohydrates, alcohol consumption, cigarette smoking, medication, menopausal status, and exercise. Because of complex interactions among these variables, it is difficult to assess how each of these factors independently affects cholesterol levels and composition.
Although total cholesterol levels are lower in persons with high aerobic fitness compared to low aerobic fitness, it has not been conclusively demonstrated that exercise training lowers total cholesterol. Measurements made before and after exercise training have produced variable results with no clear consensus as to whether or not moderate or vigorous exercise can lower total cholesterol. In studies where total cholesterol has been significantly reduced, it appears that the activities were more dynamic and vigorous in nature, such as running programs. In contrast to the variable effects of exercise on total cholesterol, endurance exercise consistently lowers triglycerides (Martin, Haskell, & Wood, 1977) . A physically active lifestyle may help to prevent the age-related rise in triglycerides normally observed in men. It also appears that endurance exercise lowers triglyceride levels more so in individuals having elevated initial baseline levels. Lower triglyceride concentrations in the blood have been attributed to increases in skeletal muscle and adipose tissue lipoprotein lipase activity resulting from aerobic training. Lipoprotein lipase is the key enzyme for the breakdown of triglyceride-rich lipoproteins. On a long-term basis, the decrease of body fat that often accompanies endurance training may be a contributing factor for this lowering effect of triglycerides due to exercise.

Like total cholesterol, the impact of habitual aerobic exercise on LDL-C appears to be quite variable. However, the majority of studies comparing endurance athletes to sedentary controls or the general population reported that athletes have lower LDL-C levels, with leaner athletes frequently having the lowest values. Although it appears that endurance training may decrease LDL-C, there is little information about the biochemical mechanism producing this change.

Endurance-trained athletes have much higher HDL-C values compared to sedentary populations (Haskell, 1984) . Although it is not yet definitive, moderate and high intensity aerobic exercise training appears to be associated with elevated HDL-C values. The primary reason for the elevation in HDL-C is an increase in lipoprotein lipase activity in response to exercise. Lipoprotein lipase accelerates the breakdown of triglycerides, resulting in a transfer of cholesterol and other substances to the HDL-C. It is interesting to note that healthy patients whose physical activity was restricted to bed rest for three to six weeks because of some type of traumatic

fracture, showed a significant decrease in HDL-C levels (Nikkila, Kuusi, & Myllynen, 1980) .
In addition to aerobic training, there are a few studies suggesting that resistance training may also improve lipid and lipoprotein profiles (Goldberg & Elliot, 1985) . Decreases in total cholesterol and LDL-C have been reported for both men and women, with women also showing a significant decrease in triglycerides, from resistance training (Goldberg et al., 1984). However, the alteration of personal lifestyle habits in conjunction with a decrease in body fat and increase in fat-free mass may contribute to these favourable changes.
An important review of this topic was performed by Kraus et al, New England Journal of Medicine 2002:

They performed a study of 111 sedentary, overweight men and women with mild-to-moderate dyslipidemia (abnormal blood lipids), who were randomly assigned to participate for six months in a control group or in different forms of exercise.

RESULTS: There was a beneficial effect of exercise on a variety of lipid and lipoprotein variables, seen most clearly with the high amount of high-intensity exercise. The high amount of exercise resulted in greater improvements than did the lower amounts of exercise (in 10 of 11 lipoprotein variables) and was always superior to the control condition (11 of 11 variables). Both lower-amount exercise groups always had better responses than the control group (22 of 22 comparisons). CONCLUSIONS: The highest amount of weekly exercise, with minimal weight change, had widespread beneficial effects on the lipoprotein profile. The improvements were related to the amount of activity and not to the intensity of exercise or improvement in fitness.

This implies that exercise can have positive effects on lipid molecules, even though it does not seem to directly influence the 'bad' lipid molecules (LDL).

EXERCISE AND LIPIDS: CONCLUSIONS

Undoubtedly exercise has a positive impact on the risk of cardiac disease, and can have beneficial effects upon lipid levels. A major exercise effect on blood cholesterol levels appears to be an increase in HDL-C as a result of aerobic training. This change is very important because HDL-C is the most critical determinant of CHD. However the impact upon LDL levels is not clear and may not be as significant.

Unfortunately the amount of exercise necessary to have a positive impact on different lipids is not known. Currently the recommendations are as follows:

REMEMBER: Studies show that briskly walking 30 minutes a day can lower the risk of heart disease by 30 percent to 40 percent. You may need to take other steps in order to effectively reduce your 'bad' lipids; if you do so, note that these drugs compliment your diet and exercise regime, they do not replace it. Lipids are not the full story and there are other influencing factors on cardiovascular health, of course.

Exercise Recommendations:

Aerobic training:
Frequency of training 5-7 days per week

Intensity of training 60-90% of maximum heart rate or
50-85% of maximum oxygen uptake or 50-85% of heart rate reserve

Duration of activity 20-60 minutes of continuous aerobic activity.
Mode of activity Any activity that uses large muscle groups, can be maintained continuously, and is rhythmical and aerobic in nature.

Resistance training
Strength training of a moderate intensity, sufficient to develop and maintain fat-free weight should be an integral part of an adult fitness program.
One set of 8-12 repetitions of eight to ten exercises that condition the major muscle groups at least 2 days per week.

Lipids are not the whole story….
Exercise has other beneficial effects of course. For example, high-sensitivity C-reactive protein (hsCRP) is promoted as an independent predictor of atherosclerotic risk. A recent study showed that cardiorespiratory fitness is inversely related to hsCRP. Nonetheless, in the absence of a significant change in diet, 6 months of aerobic exercise training does not produce a significant change in hsCRP in an at-risk population. Therefore attention to diet is very important; see below.

Reference: Response of high sensitivity C-reactive protein to exercise training in an at-risk population. Huffman et al Am Heart J. 2006 Oct;152(4):793-800

Diet and Cholesterol

Food to avoid or limit:

Fatty meats but if you do eat them cut off all the visible fat.
Sausages, goose and duck.
Pies and pastries.
Fat or oil in cooking.
Prawns, shrimp and fish roe.
Fried foods
Dairy products such as full milk, cream, cheese, butter and ice cream.
Egg yolks, limit to 2 a week.
Cakes, crisps, biscuits, sweets and chocolate.

Try to grill or steam meats instead of frying or roasting but if you do roast, place meat on a rack to allow the fat to drain off. When frying choose a vegetable oil, such as sunflower.

Healthier foods which you could try eating are as follows:

Fish, especially oil rich fish such as sardines, salmon, mackerel, pilchards and trout. This type of fish contains Omega-3 fatty acids and they are thought to lower LDL cholesterol.
Poultry (chicken, veal or turkey) but remove the skin.
Low-Fat dairy products, use semi skimmed or skimmed milk, low fat yoghurts and mono or poly-unsaturated spreads.
Foods high in polyunsaturated (found in nuts, seeds and vegetable oils) and monounsaturated (found in olive, rapeseed, walnut oil and avocado) fats.
Fruit and vegetables, you should eat at least 5 portions every day.
Garlic
Wholegrain breads
Cereals
Baked beans and red kidney beans
Pasta and rice

If buying low fat foods ensure they are labelled "low in saturated fat"

Dr C A Speed BMedSci MA Dip Sports Med PhD FRCP FFSEM
Consultant Rheumatology, Sports & Exercise Medicine
01223 306073