

# High-density lipoprotein

High-density lipoprotein (HDL), commonly referred to as the “good” cholesterol, is one of the five major lipoproteins whose role is to enable lipids, such as cholesterol and triglycerides, to be transported within the water based bloodstream.

HDL is the smallest and densest of the lipoproteins, containing the highest proportion of protein to cholesterol. In a normal healthy individual, HDL carries about 20–30% of total plasma cholesterol, whereas LDL (low density lipoprotein or bad cholesterol) carries about 70%. HDL is important for the synthesis of steroid hormones but it is more famously known for its protective role against cardiovascular disease. Reverse cholesterol transport is the method by which HDL removes excess cholesterol from tissues and arteries, and returns it back to the liver for recycling and excretion, interrupting the process of atherosclerosis (narrowing of the arteries) at key stages. Its protective properties include anti-inflammatory activity, where it protects artery walls against LDL plus an anti-oxidative activity, which in combination, may directly slow atherosclerosis.

Boys and girls have similar HDL levels but after puberty these levels decrease in men, and remain lower than those in women for all subsequent age groups. Men also tend to have smaller sized particles compared to women. Current recommendations for HDL levels are as follows:

In men HDL levels should be above 1mmol/l and in women HDL levels should be above 1.2mmol/l.

## High HDL levels:

High HDL levels can be due to secondary causes such as excessive alcohol intake, exercise and medication such as oral oestrogen replacement. Those with a Japanese ancestry are found to have high HDL levels due to a genetic deficiency of a protein, the cholesterol ester transfer protein (CETP). Very high levels of HDL have been reported to promote the development of atherosclerosis in some cases, and the mechanism of this affect is not clear. It is important to rule out secondary causes but also to determine whether a high level of HDL may be due to an inherited cause by looking at family history. A family history of longevity is reassuring whereas one of early vascular disease may prompt referral to a specialist to decide if the high level of HDL is relevant to this and whether other family members should be tested.

## Low levels of HDL

Secondary causes include certain medications, smoking, obesity, insulin resistant conditions, and specific genetic mutations such as Tangier disease. Medications which can reduce HDL levels include beta blockers, thiazide diuretics, androgens, progestogens and anabolic steroids. In smoking, a chemical found in cigarettes called acrolein stops HDL from transporting LDL to the liver, leading to higher overall total cholesterol levels. Stopping smoking can increase HDL levels by up to 10%. Insulin resistant conditions such as the metabolic syndrome and type 2 diabetes have multiple mild abnormalities in lipids, including a pattern of high triglyceride levels, high LDL levels and low HDL levels. LDL particles tend to be more toxic to artery linings and reduce the beneficial effects of HDL. Tangier disease is a disorder that causes complete absence or extreme deficiency of HDL levels and LDL levels are also usually reduced. A low HDL level is thought to accelerate the development of atherosclerosis due to an impaired reverse cholesterol transport and the absence of its other protective effects.

## Healthy ways to increase HDL levels

Lifestyle, dietary and environmental factors can have an impact on raising HDL levels, and making certain changes can have a beneficial effect. Normally a minimum of 12 weeks is recommended to see any difference resulting from making such changes. The Mediterranean diet recommends a combination of lowering saturated fat and increasing monosaturated and polyunsaturated fats to lower LDL and increase HDL. Oils such as olive, rapeseed and canola oils can improve HDL's anti-inflammatory abilities and they increase HDL without increasing the LDL and total cholesterol. They should still only be used only in small amounts as they are a concentrated source of calories. The PREDIMED study showed this type of diet raised HDL by about 0.6mmol/l and lowered triglycerides by 0.03mmol/l compared with a low fat diet. Please refer to HEART UK's fact sheet on the Mediterranean diet for more information.

Soluble fibre found in whole grains, oats, fruit and vegetables result in both a reduction in LDL cholesterol and an increase in HDL. Oily fish such as salmon and sardines contain omega-3 fats that can raise HDL and also lower LDL and triglyceride levels. A few small studies have recently shown that juices such as cranberry, purple grape or juice from pomegranates may help raise HDL cholesterol. Calcium supplements have been shown to increase HDL levels, usually in postmenopausal women. No effect has been noted in men or pre-menopausal women. Any supplements taken should be discussed with your health care professional. Dark chocolate (70% or more in cocoa concentration) can increase HDL cholesterol and also help reduce blood pressure. But as it is also high in both fat and sugar, only very small amounts should be consumed.

### Best avoided:

A diet high in saturated fat: most saturated fats increase HDL to varying degrees but also raise total and LDL cholesterol. A diet in which almost all fat has been eliminated can result in a deficit in the essential fatty acids which the body cannot manufacture itself, and in some individuals, very low fat diets have been reported to result in a significant reduction in HDL cholesterol. Trans fatty acids/partially hydrogenated vegetable oils present in many prepared foods, such as biscuits, crisps, cakes and takeaways increase LDL and triglyceride levels, and can also reduce HDL levels.

## Other positive influences on HDL levels:

**Exercise and activity:** Regular aerobic exercise (any exercise, such as walking, jogging, swimming or cycling that raises the heart rate for 20 to 30 minutes at a time, at least five times a week) may be the most effective way to increase HDL levels. Recent evidence suggests that the duration of exercise, rather than the intensity, is the more important factor in raising HDL cholesterol but both have been linked to beneficial effects on lipids. Regular aerobic exercise can increase HDL cholesterol by about 5 percent within 2 months, improving LDL levels and also lowering triglycerides.

**Losing weight/maintaining a healthy weight:** Being overweight can result in increasing LDL cholesterol, and reduced HDL. Reducing your weight can help increase your HDL levels and for every 6lb (2.7kg) you lose, your HDL may increase by 0.03mmol/l. Gaining weight or a lack of exercise and sedentary lifestyle are two of the main determinants for contributing to development of the metabolic syndrome.

**Mild to moderate alcohol consumption:** A daily intake of 1-2 units of alcohol is associated with a lower risk of coronary heart disease (CHD) in men aged over 40-45 and in women who have been through the menopause. One of the mechanisms is believed to be an increase in HDL levels. More research is needed before specific advice is given regarding this and our fact sheet on alcohol gives more detailed information on safe drinking levels.

### Medication:

Therapies to raise HDL cholesterol levels, which include statins and fibrates, have been less successful when compared to their ability to reduce LDL and triglycerides, with only minor effects on HDL levels. Tredaptive, a preparation of Nicotinic Acid (Vitamin B3) was highly effective at raising HDL, between 10-30%, but has recently been withdrawn from prescription due to the results of a recent study which showed a significant increase in the risk of non fatal but serious side effects. New medications currently being tested in clinical trials include CETP inhibitors, which lower the activity of the cholesterol ester transfer protein in the blood, which reduces the amount of LDL and also increases the amount of HDL.

The relationship between the level of HDL and coronary risk appears to level off at 1.6mmol/l and it is uncertain at present if increasing levels beyond this value is beneficial. Current guidelines identify HDL cholesterol as a strong independent cardiovascular risk factor but due to lack of outcome data so far, it is not yet seen as a specific target for intervention, and the results of clinical studies are still awaited to see if raising HDL levels results in a reduction in cardiovascular risk.