The Triglyceride/HDL Cholesterol Ratio

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For years, measurements of blood cholesterol have been used to assess the risk of heart disease.

We have been intensively educated about the role of LDL-cholesterol (LDL-C), commonly nicknamed the bad cholesterol and HDL-cholesterol (HDL-C), often called the good cholesterol.

For many different reasons, lowering LDL-C has become a primary goal in cardiovascular prevention. There is substantial evidence available suggesting a relationship between LDL-C and the risk of coronary heart disease.

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Medical professionals usually recommend lifestyle measures that lower LDL-C and statins (cholesterol-lowering drugs) are used by millions of people worldwide for the sole purpose of lowering LDL-C numbers.

However, to understand coronary heart disease and how plaques form in our arteries (atherosclerosis) we have to understand that focusing only on cholesterol is an oversimplification.

Because cholesterol is a fat substance, it can't mix with water and can therefore not travel in blood on its own. The body's solution to this problem is to bind fat molecules to lipoproteins that function as transport vehicles carrying different types of fats such as cholesterol, triglycerides (TG) and phospholipids.

It is important to understand that it is lipoproteins that interact with the arterial wall and initiate the development of atherosclerosis. Cholesterol is only one of many components of lipoproteins.

The Lipid Panel

A standard lipid panel includes total cholesterol, LDL-C, HDL-C, and TG. Although LDL-C usually gets the bulk of the attention, evidence suggests that other aspects of the lipid profile may not be less important. For example, non-HDL cholesterol is a strong marker of risk, maybe more important than LDL-C.

Relying on LDL-C alone can be misleading. For example, people with obesity, metabolic syndrome or diabetic lipid disorders often have raised TG, low HDL-C and normal or close to normal LDL-C. These individuals produce very low-density lipoproteins (VLDL) and intermediate density lipoproteins (IDL) which may increase the risk of atherosclerosis.

coronary artery disease. This relationship is true both for men and women.

One study found that a TG/HDL-C ratio above 4 was the most powerful independent predictor of developing coronary artery disease.

With the increasing prevalence of overweight, obesity, and the metabolic syndrome this ratio may become even more important because high TG and low HDL-C is often associated with these disorders.

The Triglyceride/HDL Cholesterol Ratio. What Is Ideal?

The TG/HDL-C ratio can easily be calculated from the standard lipid profile. Just divide your TG by your HDL-C.

However, when looking at the ideal ratio, you have to check if your lipid values are provided in mg/dl like in the US or mmol/L like in Australia, Canada, and most European countries.

> *If lipid values are expressed as mg/dl (like in the US);*
>
> *TG/HDL-C ratio less than 2 is ideal*
>
> *TG/HDL-C ratio above 4 is too high*
>
> *TG/HDL-C ratio above 6 is much too high*

If you are using mmol/L (most countries except the U.S.) you have to multiply this ratio by **0.4366** to attain the correct reference values. You can also multiply your ratio by **2.3** and use the reference values above.

> *If lipid values are expressed as mmol/L (like in Australia, Canada, and Europe);*
>
> *TG/HDL-C ratio less than 0.87 is ideal*
>
> *TG/HDL-C ratio above 1.74 is too high*
>
> *TG/HDL-C ratio above 2.62 is much too high*

In this article, TG/HDL-C ratio is provided as in the US (mg/dl).

Recently, analyzing the number of LDL particles (LDL-P) and LDL particle size has become increasingly common. However, this method is not universally available, is expensive, and has not been widely applied in clinical practice.

High numbers of small, dense LDL particles are associated with increased risk for coronary heart disease in prospective epidemiologic studies. Subjects with small, dense particles (phenotype B) are at higher risk than those with larger, more buoyant LDL particles (phenotype A).

Interestingly, it has been found that the TG/HDL-C ratio can predict particle size. One study found that 79% of individuals with a ratio above 3.8 had a preponderance of small dense LDL particles, whereas 81% of those with a ratio below 3.8 had a preponderance of large buoyant particles.

Apparently, people with high TG/HDL-C ratio tend to have higher than average TG. Just like all other lipids, TGs have to be transported in the blood by lipoproteins; most are carried by chylomicrons and VLDL.

What happens under these circumstances is an interchange of lipids between lipoproteins. TGs are moved from VLDL into LDL and HDL in exchange for cholesteryl ester. The result is that LDL and HDL particles become cholesterol poor and rich in TG. Then, when TGs are removed from these particles, which usually is the case, the particles shrink and become smaller as they're only transporting small amounts of cholesterol. This explains the relationship between high TG/HDL-C ratio and the number of small LDL particles.

However, the number of LDL particles present in the blood may be more important than particle size. Furthermore, particle number appears more important than how much cholesterol is carried within these particles. Blood levels of LDL-P and apolipoprotein B are strongly correlated with the risk of coronary heart disease. Both these measurements reflect the actual number of LDL-particles.

But, can the TG/HDL-C ratio reflect particle number? As a matter of fact, it can, to some extent. Take a look at the LDL-C, the amount of cholesterol carried in LDL-particles. A high TG/HDL-C ratio indicates that these particles are small. A small particle carries less cholesterol than a large particle. Therefore, a greater number of particles is needed

LDL-particles, unless LDL-C is very low.

Triglyceride/HDL Cholesterol Ratio and Insulin Resistance

Insulin resistance is a condition in which cells fail to respond to the normal actions of insulin. Most people with this condition have high levels of insulin in their blood. Insulin resistance appears to play a significant role in coronary heart disease and can predict mortality. The condition is common among individuals with abdominal obesity and the metabolic syndrome.

A study in which most of the participants were Caucasian and overweight identified TG/HDL-C ratio of 3 or greater as a reliable predictor of insulin resistance.

However, not all studies have found the TG/HDL-C ratio to be associated with insulin resistance. For example, in a relatively small study of 125 African American participants, neither fasting TG nor the TG/HDL-C ratio was shown to be a marker of insulin resistance.

Although confirmatory studies are needed, data suggests that an elevated TG/HDL-C ratio may be clinically useful for the prediction of insulin resistance.

How to Improve Your Triglyceride/HDL Cholesterol Ratio

Improving your TG/HDL ratio aims at lowering TG, raising HDL-C or preferably both.

If you are overweight, losing weight will probably lower your TG levels and so will reducing your intake of added sugar. Studies have found

Low-fat diets are usually not effective in lowering TG. In fact, low-fat, high-carbohydrate diets may raise TG. Adding omega-3 fatty acids, regular exercise and limiting alcohol may be helpful to reduce TG.

Similar methods may be useful for raising HDL-C. Losing weight, exercising and not smoking may help. In controlled trials, low-fat, high-carbohydrate diets decrease HDL-C, thereby raising theTG/HDL-C ratio.

In 1961, a group of investigators from the Rockefeller Institute, led by Pete Ahrens published a paper entitled "Carbohydrate-induced and fat-induced lipemia".

The authors pointed out that fat-induced increase in TG following a meal is a postprandial phenomenon (we all have high TG for a few hours following a fatty meal) caused by chylomicrons is different from the carbohydrate-induced rise in TG (later found to be caused by an elevation of VLDL).

These findings have been confirmed in several more recent studies. Despite this, low fat, high carbohydrate diets are still being recommended as a primary option to reduce the risk of heart disease.

Although low-fat diets may help to lower LDL-C, low-carbohydrate diets are more effective in improving the TG/HDL-C ratio.

This suggests that solely selecting LDL-C as a target in cardiovascular prevention is an oversimplification, and may have led to wrong conclusions regarding the relationship between diet and heart disease.

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