Webinar 4 Handout:

INFLAMMATION

We hear the word inflammation all the time - on the internet, from blogs, on TV, in magazines, from our doctors - but do people know what it really is? The idea of inflammation can be kind of confusing for most people. It's essentially the body's reaction to stress. That stress can come from diet, lifestyle, environment, or an infection. When you catch a cold, inflammation is your body's way of fighting it off. When you cut your skin, inflammation is the way it heals itself. This short term inflammation can be a good thing, but there's also such thing as too much of a good thing - and that's the inflammation that everyone is talking about.

Prolonged, chronic inflammation is linked to heart disease, obesity, diabetes and just about every other chronic disease that can have severe, life-threatening consequences. It's also related to the foods that we eat, and knowing which foods cause inflammation and which foods fight it is one of the best ways to reduce chronic inflammation and keep your body disease-free and healthy.

A Few Definitions

- **White blood cells** play a primary role in the body's immune system and are always on the lookout for invading microorganisms and foreign particles like germs, infections or toxins. When they spot an invader they attack and eliminate it to keep the body safe and healthy.

- **Leukocytes** are white blood cells. There are five types of leukocytes: neutrophils, eosinophils, basophils, monocytes, and lymphocytes.

- **Antibodies** (made by **leukocytes)** are proteins made by the immune system when an invader is detected. They can directly attack and eliminate the invader, activate other proteins to help, and promote inflammation which helps prevent the infection from spreading. Each kind of antibody is unique and specific to one type of antigen, or invader.

- **Antigens** are any substance that cause the immune system to make antibodies. They can be a foreign substance from the outside environment including chemicals, bacteria, viruses, or pollen, or can be bacterial toxins or tissue cells made in the body.

- **Inflammatory markers** are types of cells that increase during periods of inflammation. Looking for these markers help us detect when inflammation is present and can help identify the cause of the inflammation. A common marker is **c-reactive protein (CRP)**, a protein made in the liver. Amounts of **CRP** in the blood increase during inflammation.

What is Inflammation?

Inflammation is a process in which the body's **white blood cells** (**leukocytes**) and other types of cells help protect it from infection and foreign substances (**antigens**). The stimulus for inflammation can be something like a cut or splinter, but diseases also cause inflammation. Typically any disease ending in "itis" such as bronchitis or dermatitis is a condition of inflammation. For example, bronchitis is an inflammation of the lining of your bronchial tubes, which carry air to and from your lungs. The goal of inflammation is to remove harmful stimuli like damaged cells, irritants, or pathogens in order to begin the healing process and it can result in redness, swelling, heat, pain, or loss of function in the affected body part.

There are two kinds of inflammation: acute and chronic.

- **Acute inflammation** is what most people are used to. It's short term and usually happens to help the body heal from a cut or wound which is a good thing! During acute inflammation **leukocytes** and plasma proteins, such as **antibodies**, are sent to sites of infection or tissue injury. This process results in the visible symptoms: redness, swelling, heat, and pain. Eventually, the protective response works, the invader is eliminated, the tissue returns to normal, and the symptoms go away. However, if the invader persists or the normal process of healing doesn't work, the acute inflammation may not resolve the problem but instead turn into chronic inflammation.

- **Chronic inflammation** is definitely not a good thing and appears to underlie most, if not all, chronic diseases including cardiovascular disease, type 2 diabetes, chronic kidney disease, Alzheimer's and cancer. Chronic inflammation is a prolonged condition in which inflammation, tissue injury and attempts at repair exist altogether. It's a whole different process from acute inflammation and definitely isn't beneficial for the body, immune system, or overall health. Though acute inflammation is a good thing, chronic inflammation is just too much of it. It's as if there are too many cooks in the kitchen trying to fix the problem and more and more just keep coming. The result is pure distress.

Chronic Inflammation and Diet

Though chronic inflammation is a big part of most chronic diseases, there are plenty of other ways to experience inflammation and its negative health consequences. Excessive stress, poor dietary habits, environmental toxicity, lack of sleep, and lack of exercise all contribute to low levels of chronic inflammation that often go undetected and can slowly build up for many years. This buildup is what will eventually lead to the development of chronic disease such as type 2 diabetes, heart disease, or cancer. Though there are many things you can do in your life and environment to prevent this from happening, eating a healthy diet is one way to prevent chronic inflammation.

How can diet help? First of all, chronic inflammation is strongly tied to weight, and weight is strongly tied to diet. One study showed that overweight participants who dropped 5% or more of their body weight showed significant decreases in levels of **inflammatory markers**. Adipose tissue (fat) releases proinflammatory cytokines, chemicals that *promote* inflammation, but there is no increase in the anti-inflammatory adipokines that work *against* inflammation. This imbalance can lead to all sorts of negative health consequences like insulin resistance and type 2 diabetes. Secondly, specific foods can either cause inflammation in the body (usually the unhealthy foods) or help to fight it (usually the healthy foods). Eating a balanced and healthy diet can not only help you maintain a healthy weight but can offer nutrients that will keep your body free of inflammation and its consequences.

Nutrients That Promote Inflammation

- **Sodium** intake is linked to blood pressure and too much sodium can lead to hypertension (high blood pressure.) Research has shown an association between hypertension and inflammation. As sodium intake increases, levels of **inflammatory markers** like **CRP** (which are measured through a simple blood test) increase as well. One of the best ways to keep sodium levels in check is to limit consumption of processed foods like packaged breads, canned soups, deli meats, and potato chips.

- **Sugars** can wreak inflammatory havoc in both solid and liquid form. Research shows that foods with a high glycemic index can cause a decrease in levels of antioxidants in the blood including vitamin E and lycopene. This causes a rise in free radicals, tissue damage, and proinflammatory cytokines, which lead to inflammation and are also powerful markers of chronic diseases. Other studies have found that high consumption of sugar sweetened foods and drinks increase inflammatory activity by increasing levels of haptoglobin, another marker of inflammation, as well as **CRP**.

- **Trans fats** are naturally found in small amounts in animal products like meat and in processed foods as partially hydrogenated oils, added by manufacturers to increase the shelf life of products. They have zero health benefits and plenty of risks. Research has shown that a high intake of trans fatty acids increases certain markers of inflammation in the body including levels of **CRP**, which is also a risk factor for heart disease. Avoid ALL trans fats and products that list partially hydrogenated oils in the ingredients. (Though FDA has banned trans fats from food production, they won't be completely eliminated as some exist as a byproduct of oil production.)

Nutritious Life Tip: Avoid all types of foods that contain trans fat, high amounts of sodium, added sugar, nitrates, and preservatives to help keep your body inflammation free and prevent chronic disease. Processed meat, greasy fast-food, soda (even diet soda!), other sugar sweetened beverages, and packaged snack foods like salty chips should stay on the supermarket shelves, not on your dinner table.

Nutrients That Fight Inflammation

- **Antioxidants** are compounds capable of fighting cellular oxidation and neutralizing free radicals, which can trigger inflammation and damage DNA. There are hundreds of different antioxidants that each do different things: anthocyanins, vitamin C, vitamin E, beta-carotene to name a few. They're found in a wide variety of fruits, vegetables and legumes including apples, artichokes, berries, kidney beans, plums and sweet potatoes.

- **Anthocyanins** are antioxidants found in the skins of apples and berries. In one study eating a mixture of anthocyanins reduced the inflammatory response in participants and researchers found anthocyanins effective in helping anti-inflammatory responses.

- **Cinnamaldehyde** is an antioxidant found in cinnamon that inhibits expression of inflammatory cytokines.

- **Curcumin** is an antioxidant found in the spice turmeric that inhibits pro-**inflammatory markers** like tumor necrosis factors (TNF), chemokines, and interleukins. Turmeric is a relative of ginger and best used in recipes like curry or other Indian-inspired dishes.

- **Organosulfur compounds** found in garlic and onions have been found to decrease amounts of iNOS (the enzyme that makes nitrous oxide which has an inflammatory function), inhibit other inflammatory enzymes like cyclooxygenase and lipooxygenase and decrease production of inflammatory signaling molecules in the blood.

- **Phenolic derivatives** and other chemicals found in honey can play an important role (alone or in combination) in the antitumor and anti-inflammatory effects of honey in the body. In one study honey was effective in decreasing inflammation in inflammatory bowel disease.

- **Vitamin C** has lots of anti-inflammatory effects. Fruit intake, dietary vitamin C, and vitamin C in the blood has been shown to be significantly and inversely associated with concentrations of **CRP**. Vitamin C is in lots of fruits and vegetables including broccoli, tomatoes, red peppers, strawberries, and citrus fruits.

- **Omega-3 fatty acids** are part of the polyunsaturated fat family that are essential fats since our body cannot make them. Omega-3 fatty acids, including EPA, DHA and ALA, reduce inflammation by blocking the production of cytokines by interfering with the conversion of arachidonic acid in different pathways.

Nutritious Life Tip: It's important to remember that many foods have a number of different components that make them anti-inflammatory, not just one. Strawberries, for example, contain the antioxidant anthocyanin and are also packed with vitamin C and glutathione. This is why it's so important to get these nutrients from whole foods first. Supplements are meant to do just that - supplement the diet. They don't deliver the complete package that food does. Eating well not only gives you helpful compounds to fight inflammation, like antioxidants, but also helps you maintain a healthy weight and thus, prevents diabetes, heart disease, and other conditions associated with inflammation. It's all connected!