

Notes from [Healing the Hyperactive Brain](#), Dr. Michael Lyon:

p.p. 86 - 121

This document summarizes the work of Dr. Michael Lyon in his book [Healing the Hyperactive Brain](#). The focus here is specific to how proper fats and nutrition affects the ability of the brain to function. Children and adults who have a hyperactive brain associated with ADD/ADHD are more vulnerable. All of us can benefit from this information.

Fats & the brain

DHA is a highly fragile fatty acid (of the omega-3 fatty acid family) and is consumed by normal cellular processes. It is the lowest viscosity oil in the body. It is the most fragile of all the fatty acids, becoming oxidized very easily.

It must be continually supplied to the brain throughout life in order to maintain adequate brain function. If the dopamine containing nerve endings are rich in DHA their processing speed is extremely rapid.

DHA is also of critical importance in the development and function of the eye. In order for the processing of light information to occur in an extremely rapid fashion, the membranes of retinal cells are composed of a very high percentage of this very fluid fat.

The brain makes up only two percent of the body's weight, consumes nearly 25% of the body's supply of oxygen. Therefore it is the most aerobically active region of the body and given this high predisposition to consume oxygen, it is the brain region fatty acids that are prone to becoming oxidized. Since DHA is so prone to becoming damaged through oxidation, anything that increases oxidation within the brain will also increase the need for DHA.

A wide range of agents will contribute to the need for more DHA including:

- trauma, or emotional stress. Both will increase the quantity of circulating stress hormones such as adrenaline and cortisol. Inside the brain, stress hormones are rapidly broken down or oxidized. These oxidized byproducts must then be quickly removed from the brain because they can cause oxidation damage to brain cells.
- Neurotoxic chemicals . Heavy metals such as lead or mercury, pesticides, first or second-hand smoke and the breakdown products of amphetamines like Ritalin or Dexadrine are chemical substances that can increase oxidative stress in the brain.
- Chronic illnesses. Allergies or inflammatory disorders can increase oxidative stress in the brain.

Therefore, individuals under stress, suffering from illness or who have significant exposure to neurotoxic chemicals all have an increased need for both DHA and antioxidants.

Sources of DHA:

- DHA is a rare nutrient found only in cold water fish e.g. salmon, sardines and certain aquatic plants.

- The body can manufacture DHA from ALA (alpha linolenic acid), an omega-3 fatty acid found in flax oil. This conversion process depends on the ability of the body to make the ALA into an even more unsaturated fatty acid and lengthened molecule. One of the key enzymes needed for this process is delta-six desaturase. Delta-six desaturase is blocked by a variety of toxic influences including excessive stress hormones, tobacco smoke, alcohol, chronic infection, heavy metals, trans-fatty acids (i.e. vegetable fats hydrogenated to create thickened or solidified oil-based products e.g. vegetable oil shortening), drugs and pesticides. Cells containing delta-six desaturase also need adequate quantities of zinc, magnesium, vitamin C, vitamin E and certain B vitamins.
- One product that can be used to supplement a child's diet with DHA is Ultracare for Kids. Ultracare is a hypoallergenic white powder made from rice protein and rice carbohydrate and can be used as the base for a smoothie drink. Contains significant amounts of DHA derived from algae as well as high amounts of calcium, vitamins and minerals. It also contains FOS (fructooligosaccharides) which helps to restore normal bacteria to the child's intestinal tract. (Can use a natural sweetener such as sugar-free stevia extract.)

Other critical fats:

- Omega-6 fatty acids.
 - The brain contains large amounts of one omega-6 fatty acid known as AA (arachidonic acid) essential in the function of the brain and immune system. Is abundant in animal fats and other common dietary sources.
 - GLA (gamma linolenic acid) is important in brain and immune system function. While uncommon in the diet it is produced in the body through enzymatic conversion of the more common vegetable-derived omega-6 fatty acid called LA (linoleic acid). LA is the primary fatty acid in most vegetable oils and is readily available. GLA can be supplemented from use of evening primrose oil, borage oil or black current oil.
- Phospholipids. These are large molecules that have special properties that make them very important structural elements of cell membranes. Neurons in the brain depend upon the provision of adequate quantities of important phospholipids in order to function normally.
 - One phospholipid, PS (phosphatidylserine) has received great attention as a potential enhancer of brain function. Studies have now shown that supplementation with PS can improve memory and concentration in both normal and brain disordered adults (Crook, 1991). In response a supplement called PS-IQ (which contains high amounts of PS as well as the essential fatty acids DHA (from tuna oil) and GLA (from evening primrose oil)) is available.
- Nutrients required for adequate processing of fatty acids with the body:
 - Eating a balanced, whole foods diet
 - Dietary supplementation with additional magnesium, zinc, B complex, vitamin C and vitamin E – all critical in the function of enzymes which the body uses to manufacture fatty acids for the brain, immune system and organs.
 - Vitamin C and vitamin E are important antioxidants; yet, bioflavonoids may play a far more important role in protecting the brain from oxidation. A group of

bioflavonoids known as proanthocyanidins have been shown to be particularly effective as antioxidants for the brain. Found in grape seed extract, pine bark extract (Pycnogenol) and Ginkgo biloba extract. A product known as AD-FX (or Attention FX in the U.S.) combines ginkgo biloba and American Ginseng extracts has been observed to significantly improve behavior and cognitive performance in 90% of 37 children with ADHD.

- Avoid bad fats:
 - **Saturated fats.** Naturally occurring fats from meat and dairy products as well as tropical oils (palm and coconut). Moderate intake of these is key.
 - **Trans-fatty acids.** Are the fats that are hydrogenated into thick or solid fats e.g. vegetable oil shortening. Hydrogenated vegetable oils have been shown to be significantly toxic and are banned in some countries. They are unnatural substances that interfere with the normal metabolism of fats and they may actually block the production of critical brain fats such as DHA. Avoid all together.
 - **Rancid fats.** Oils that have become spoiled through oxidation. Polyunsaturated vegetable oils are particularly susceptible to oxidation damage. Production and storage methods used generally lead to high levels of oxidation. These oxidized fatty acids, once ingested, will tend to create further oxidation of fatty acids within cell membranes adding significantly to the oxidative stress inside the body. Avoid using commercial vegetable oils, except extra virgin olive oil since this oil is processed at much lower temperatures and is more stable because it is primarily monounsaturated. Instead obtain polyunsaturated oils by eating fresh, raw nuts and seeds.

Summary:

- Managing your brain fats involves a combination of:
 - Intelligent supplementation with fatty acids (and perhaps phospholipids like phosphatidylserine)
 - Micronutrient support (magnesium, zinc, B complex (i.e. thiamine=B1; pyridoxine=B6; niacin and B12), vitamin C vitamin E) to enable the body to adequately process, manufacture and metabolize critical brain fats
 - Antioxidant support using specific bioflavonoids (such as Ginkgo biloba) to preserve and protect these vital molecules
 - Thoughtful search for causes of increased oxidative stress within an individual's brain. These factors are both the antecedents and triggers which are at the heart of ADHD

Other nutritional factors associated with brain functioning:

- Protein & the brain.
 - It is well documented that children who are deprived of adequate protein early in life will suffer from a permanent reduction in brain size and a significant loss in intelligence.

- Children who skip an adequate breakfast (with protein) will tend to be more irritable, easily distracted and hyperactive.
 - Protein provides the amino acids needed to make neurotransmitters and it helps to smooth out rising and falling blood sugar levels, which can have an adverse impact upon brain function. Protein also provides to the brain the building blocks for several important neurotransmitters (the chemical messengers that allow brain cells to talk to each other). I.e. if protein is efficiently digested, it will be broken down completely into amino acids. The amino acids tyrosine and phenylalanine are used to make norepinephrine and dopamine; glutamine is used to make GABA; and tryptophan is used to make serotonin.
- Iron & the brain.
 - Iron is an important component of a protein called hemoglobin that is used to carry oxygen throughout the body. Iron is also incorporated into important enzymes known as cytochromes. The family cytochrome enzymes include some that detoxify drugs and poisons; and, importantly for the brain since the brain demands 25% of the energy from the body, other cytochromes are found in every cell and are used by the cell to generate energy (from within the mitochondria). In particular the dopamine producing neurons in the brain's executive centers contain the highest concentration of iron (Youdim, 1983)
 - Iron deficiency can lead to cognitive and behavioral problems in children because without adequate iron, brain cells simply cannot manufacture enough energy to perform adequately.
 - Studies have demonstrated that iron supplementation in children with ADHD can improve behavior and cognitive performance (Sever, 1997)
- Magnesium & the brain.
 - Magnesium is one of the necessary cofactors required by the enzyme delta 6 desaturase. This is the enzyme responsible for the conversion of vegetable derived omega-3 fatty acids to the brain critical fatty acid, DHA (hence, if levels of magnesium are less than ideal, DHA deficiency is very likely to exist). Magnesium is also a calming mineral that relaxes nerves and muscle and diminishes the effects of stress. Stress of all kinds (including drugs like caffeine, cortisone, Ritalin and Dexedrine mimic stress) will increase the loss of magnesium from cells and body through the kidneys.
 - Magnesium deficiency can also lead to muscle tension, hyperirritability of nerves leading to magnification of stress.
 - Magnesium supplementation is one of the safest, simplest and least expensive that can be done.
- Zinc & the brain.
 - Zinc is responsible for the activation of numerous enzyme systems within the body. Zinc also plays a key role in the body's ability to excrete toxic metals. I.e. it is the primary stimulus for the production of a protein within cells called

metallothionein, a complex protein that acts like a metal cleanup service traveling throughout the cell, and capturing toxic metals. In addition, zinc is an important component of the enzyme delta 6 desaturase, which converts vegetable derived omega-3 fatty acids to the brain critical omega-3 fatty acid DHA.

- Low-grade zinc deficiency will result in weakened immune system responses and diminished digestive system function.
- Dietary supplementation with modest amounts of zinc in children and adults with ADHD is safe and prudent.
- Calcium, Chromium, Selenium & ADHD
 - And for those with dairy-product allergies in general, calcium deficiency is a concern. Supplement via rice milk, soy milk, UltraCare for Kids, Calcium citrate, and microcrystalline hydroxyapatite (manufactured by Metagenics).
 - Chromium is thought to play a vital role in the regulation of blood sugar. It is a key component in combination with niacin and certain amino acids, in the formation of a complex molecule known as glucose tolerance factor GTF. GTF has strong insulin-enhancing properties, which works by helping insulin to bind with receptors located within cell membranes. If a person has inadequate stores of chromium, their cells will be relatively insensitive to insulin – tending to create a situation where excessive amounts of insulin must be released by the pancreas following meals to prevent blood sugar from rising too high, later resulting in an excessive drop in blood sugar and symptoms typical of hypoglycemia e.g. weakness, shakiness, sweating, rapid heartbeat, irritability or moodiness, cognitive problems, hyperactivity or lethargy. Chromium supplementation and avoidance of sugary foods, frequent meals containing an adequate balance of protein, carbohydrate and fat is best to keep the brain on an 'even keel'.
 - Selenium is a mineral and a key factor in the activation of several highly important enzymes including antioxidant enzymes known as glutathione peroxidase. Selenium also plays a major role in thyroid function via the conversion of T4 (a relatively inactive hormone) into T3 (an active hormone) through an enzyme called 5' deiodinase, which depends upon selenium for its activity. Inadequate T3 activity may result in profound diminishing of brain function. Finally, selenium is important to ward off mercury binding to cells. This is because selenium and mercury are quite similar chemically and they bind to similar sites on sulfur rich proteins. Ensuring an adequate selenium intake may be one of the ways to force out mercury contaminants since they compete for the same spots to bind on cells.

Note, the most important way to ensure an adequate intake of nutritional trace minerals is to eat a whole foods diet with plenty of whole grains, fruits and vegetables. Seaweed is a rich source of trace elements and should be included in one's diet if possible.

- Phytochemicals.
 - Carotenoids are pro-vitamins (i.e. can be used by the body to manufacture vitamins). Need to be combined with other antioxidants such as vitamin C vitamin E and bioflavonoids. Eat colourful vegetables such as carrots, squash, and sweet potatoes.

- Bioflavonoids are a vast family of chemicals with several thousand forms. Have gained notoriety for their potent and diverse antioxidant capabilities. Green tea, ginkgo biloba extract, grape seed extract and pine bark extract are great sources.
- Chlorophyll is being increasingly recognized as having antioxidant effects and assisting in the removal of heavy metals by binding them within the gastrointestinal tract.
- Carbohydrates – in the form of fibre.
- Oligosaccharides are a special class of carbohydrates. They are particularly important in the function of the immune system. Can be found in certain extracts of the aloe vera plant. Cold-FX is 20 times more potent as an immune stimulant than Echinacea.

One way to easily increase phytochemical intake is through dehydrated plant food powders, some of which are available in capsules or tasty fruit bars.

- Finally --- An adequate intake of water. A good size glass first thing in the morning – and take a one liter container of water to school.