

## Nutritional Deficiencies

Most people have heard about nutritional deficiencies, that is, not having enough of a specific nutrient or nutrients in your diet, but are not always sure what this really means, or how you get this problem. First of all, it must be realized there are two entirely different types of nutritional deficiencies, absolute nutritional deficiencies and marginal nutritional deficiencies.

Most people suffering from absolute nutritional deficiencies 'know' they have these deficiencies because absolute deficiencies are usually associated with specific nutritional diseases, such as scurvy resulting from an absolute deficiency of vitamin C. This is the reason the British sailors were called 'limeys', as even before vitamin C was discovered, the British Admiralty had observed that having the sailors eat limes prevented scurvy. Hence all British sailors were required to eat a lime or the juice of a lime every day on long voyages, of course they needed a bit of grog or rum to wash it down!

Absolute deficiencies are based upon depletion of nutrients because these nutrients are almost wholly absent from the diet. In contrast, marginal deficiencies are just lack of specific nutrients in large enough quantities to handle 'peak' demands for these nutrients. With marginal deficiencies, at normal levels of activity and function, the nutrient levels present are sufficient to support basal body and brain function. However, when the level of activity or intensity of the function reaches a certain level, the body or brain just runs out of enough of specific nutrients to maintain optimum function.

While absolute nutritional deficiencies announce their presence by creating observable dysfunction, marginal nutritional deficiencies often go unnoticed. Since marginal deficiencies permit normal or low levels of activity and function, and only result in decreased mental and physical performance when we are under stress, they are often not acknowledged. Rather, the dysfunction caused by these marginal deficiencies is often attributed to other factors such as being stressed

or being physically tired, which are actually the symptoms of marginal nutritional deficiencies.

In marked contrast to people in developing countries suffering absolute nutritional deficiencies due to lack of food, people in developed countries seldom suffer from macronutrient deficiencies, but commonly have marginal nutritional deficiencies for several reasons including lifestyle and food choices. Many people eating a typical Western diet are overfed but malnourished, leading to marginal nutrient deficiencies.

While junk and fast foods provide ample amounts of most macronutrients, in fact too much, they are commonly lacking in adequate amounts of many nutrients, especially the micronutrients, partly because they contain too much sugar and fat. Although sugar and fats are not 'bad' by themselves, but actually necessary for life as they provide the energy to live, they contain absolutely 'NO' nutrients yet make up a sizeable portion of many western people's diet.

### Recommended Daily Allowance (RDAs)

Many people have been told if you eat a balanced diet, that is all you need to be healthy, but what do they mean by a balanced diet? Usually this refers to eating from the food pyramid, with most of your kilojoules coming from fruits, vegetables and cereal grains, then from proteins like meats and dairy products and the least from fats, and then consuming enough of these foods to give you 100% of the Recommended Daily Allowance (RDA) of all of the nutrients per day.

The average person is familiar with the concept of RDA or Daily Values (DV) of a nutrient, usually expressed as a percent of RDA on cereal boxes and vitamin and mineral bottles. But exactly what is an RDA or DV and what does this mean?

To understand this, you first have to understand the origin of the RDAs used today. RDAs were originally the absolute minimum amount of a specific nutrient – vitamin or mineral – that you needed in order not to develop an overt nutritional deficiency disease. The original RDAs were established following World War II when millions of people in Europe were starving, and the United States had surplus food, however, not enough surplus food for everyone. So research was done to find out how little of each major nutrient you could consume just to stay alive and not die or be overtly ill from a nutritional deficiency disease. The initial RDAs represented a disease deficiency guideline, how much you had to ingest not to develop a deficiency disease, and therefore had little to do with what levels of nutrients were required for optimum health and function.

### Mental Performance and Brain Integration

Mental performance relies totally upon maintaining integrated brain function under stress or Brain Integration. Brain Integration is a new understanding of brain function derived from the latest research of how the brain works. In the old view of the brain it was believed that different types of thinking and memory were performed in specific areas of the cortex based on sensory input. Therefore, you either accessed these functions and could easily think in certain ways and remember well, or you couldn't.

The new view of the brain is far more dynamic. Thinking and memory are no longer seen as being based in single hierarchical systems, with specific functions performed entirely in one location, but rather are now seen to be widely distributed systems with processing done at many different locations and levels throughout the brain.

This multiplexing and parallel processing is highly efficient and provides enormous processing capacity in a very small space. But it means the brain is 'time-bound', that is dependent upon the synchronization and precise timing of neural flows both within

processing centres and between these centres to maintain efficient function.

Because even simple mental processes are performed in many different parts of the brain, often at different speeds, to create coherent output in the form of thinking requires the integration of all these separate processes. Thinking at higher levels requires even more brain regions to become involved, relying on even higher levels of integration. The highest level of thinking is found in the executive, decision-making functions of the frontal lobes of the brain, and thus requires the highest levels of integration to work effectively.

The major executive functions of the frontal lobes have been identified as: higher-level reasoning, analytical thinking, multi-tasking, decision-making and problem solving as well as lateral, creative thinking. Higher-level reasoning requires access to the ability to multi-task. This is because analyzing possible outcomes of your actions requires the ability to consider them all at the same time. Decision-making is just the ability to choose between the available options. It is also through our executive functions that we can appreciate cause and effect, and thus anticipate the possible outcomes of our actions.

Our executive functions are the source of our lateral thinking and creative problem solving. These are critical resources needed by every person or decision-maker, and if they are lost through lack of brain integration, the only option left is emotionally driven, reaction-oriented thinking. So solution-oriented thinking is replaced by problem-oriented thinking, and you just cannot see alternate choices. From the perspective of brain function, there is a loss of integrated neural flows due to these stressors, particularly those supporting frontal lobe functions.

Clearly, any loss of synchrony or timing in the transmission of neural flows will disrupt mental processes dependent upon the integration of these flows for function, or stated another way, cause a loss of

brain integration. The primary factors disrupting brain integration are mental, emotional, physical or biochemical stress. Mental stress is often caused by deadlines to meet, with too little time to meet them. Emotional stress commonly results from interpersonal disputes or differences of opinion, while one of the most common forms of physical stress affecting brain integration is fatigue resulting from lack of sleep.

For most people these factors causing loss of brain integration are transitory: mentally, you have a big deadline to meet one week, but the next you're on vacation; or emotionally, you've had a very difficult meeting with a person that really pushes your buttons in the morning, but in the afternoon you have a meeting with one of your best friends; or physically, one day you're exhausted from meeting the big deadline the day before, but the next day you feel great after a good night of sleep.

Physiological stress is actually the origin of most of the symptoms we experience as our mental and physical stress. However, physiological stress is biochemical in nature and a direct result of our emotional states, particularly activation of our survival emotions, and thus subconscious in origin.

When the survival centres in the brain stem and Limbic system fire in reaction to perceived 'threat or danger', they initiate a whole cascade of physiological events that prepare the body for 'Fight or Flight!' For humans, this 'threat or danger' can be to either our physical or psycho-emotional selves, unlike animals in which this system is only activated to stay alive

### Fight or Flight – the Origins of Stress

When a potentially threatening or dangerous stimulus is perceived by the Amygdala (the emotional survival system control centre) it activates the Fight or Flight system. This, in turn, activates a whole series of physiological events. The Central Nucleus of the Amygdala fires signals to the Hypothalamus causing both hormonal and

Autonomic Nervous System (ANS) activation. The ANS stimulates immediate release of adrenalin and cortisol from adrenal glands, and a redistribution of blood through out the body.

The release of adrenalin increases the heart rate, blood pressure, and release of glucose into the blood, and increases the tone or tension of the muscles and increases the power of muscle contraction. (This is why a woman may be able to lift a car off her child pinned beneath it!).

Cortisol release inhibits the immune system to prevent inflammation, and causes rapid release of glucose needed for energy. Blood is redistributed from the digestive system to the heart, lungs and muscles so you can Fight or Flee. At the same time, the ANS causes muscle tone to increase, especially in the postural muscles of the spine and neck. (Can you remember having a pain in the neck or the achy back after a particularly stressful meeting or interpersonal conflict?)

Indeed, the only way the subconscious emotional system has of alerting our conscious mental and psychological systems that there is something to attend to is through activation of the physiology of stress.

Stress also appears to be the primary trigger for most people to the switch from their Frontal Lobe solution-oriented thinking to their Limbic problem-oriented thinking. This represents the switch from a mentally resource rich state of higher-level reasoning, analytical thinking, multi-tasking and lateral creative thinking into a knee-jerk reactionary state based on what we did last time to survive. This compromises both the quality, and very often even the quantity of our decision-making. Clearly the loss of our creative problem solving skills leads to poor quality decision-making, as only a limited number of choices are perceived – other choices are not even considered.

## Loss of Executive Functions due to Marginal Nutritional Deficiencies

Losses of these frontal lobe executive functions that normally inhibit emotional reaction in favour of rational thinking leave the survival-oriented emotional centres in charge of decision-making. Thinking shifts from carefully considered decisions based on anticipating all of the various outcomes and thus selection of the most effective choice, to emotional reaction where generally only one choice is perceived. Thus, the presence of marginal nutritional deficiencies may result in a shift from creative, lateral solution-oriented thinking to reactive problem-oriented thinking.

This is why nutritional supplementation may play an important role in maintaining high levels of mental performance when you are under stress. Supplementation that provides a complete spectrum of the key precursors of neurotransmitters, as well as an effective matrix of ancillary nutrients needed to maintain rapid neurotransmitter production can make the difference between maintaining your executive decision-making and problem solving skills, or slipping into emotionally-based reactive thinking and decision-making.

In addition, the executive functions must now use much of the available nutritional resources just to inhibit emotional reactions (think of the effort to control your anger when someone has done something really stupid that just 'pisses you off!'), and stress resulting from strong emotional reactions generates biochemical activity that directly competes with the executive functions for the limited supplies of nutrients in the brain. When push comes to shove, it is the Limbic survival centres that get the nutrients remaining, as the frontal lobe thinking centres are 'turned off', or rather put on 'standby' by reduced blood flow.

This is the link between marginal nutritional deficiencies and brain integration. This is why we can often hold our brain integration and maintain access to our executive functions allowing us to make clear,

effective and creative decisions when not under the stress of deadlines or external emotional situations, but then suddenly lose these critical functions exactly when we need those most!

## Nutrients' Role in Maintaining Optimum Mental Function

There are four primary nutritional groups required to support and maintain peak mental performance. These are:

- 1 Amino Acids to make neurotransmitters;
- 2 Fatty Acids to maintain effective, stable membranes;
- 3 An Ancillary Nutrient Matrix required to manufacture neurotransmitters and neuronal membranes; and
- 4 Antioxidants to protect neuronal function.

Each of these nutritional factors is discussed briefly below.

The other major function of vitamins and certain minerals is to scavenge 'free radical' molecules. Free radicals are molecules 'broken' during active metabolism leaving them with an unpaired electron, and the brain is one of the most metabolically active sites in the whole body.

The presence of this unpaired electron sends free radicals on a fanatic quest to find another electron at any cost. So strong is their lust for the 'missing' electron that they will literally 'tear apart' other molecules like DNA, membrane fatty acids and both structural and enzyme proteins to satisfy this need. This theft now leaves the damaged molecule with an unpaired electron often initiating a chain-reaction of molecular destruction.

The result is free radical damage called oxidative damage, and hence, the need for cells to have 'antioxidants' to protect themselves from this damage. Antioxidant molecules like vitamins B1, B5, C and E and the minerals lithium, zinc and selenium have the capacity to quench these free radicals and are often called free radical scavengers.



Having a sufficient supply of these protective molecules is critical to normal brain function and guards against damage to the hippocampus, the short-term memory centre, and other brain structures!

Nootropic herbs act to improve learning and memory, yet have no known side effects and extremely low toxicity. Two of the best-documented nootropic herbs are *Gingko bilboa* and *Barcopa monniera*. *Gingko* is the oldest known species of tree dating back 300 million years, and its leaves have been used in Chinese medicine for thousands of years. *Gingko* is used to improve cerebral circulation, mental alertness and overall brain function.

Recent studies have shown *Gingko* to significantly improve cerebral circulation, enhance memory, especially in the hippocampus, the short-term memory centre and working memory of the frontal lobes. A number of other studies have suggested *Gingko* may enhance cognitive functions in general, and no negative affects have been observed even at very high doses.

*Barcopa monniera* is often called by its Indian name, *Brahmi*, and like *Gingko* in China, has been used in traditional Indian Ayurvedic medicine for memory enhancement and insomnia for a thousand years. Extensive studies indicate that extracts of *Barcopa* facilitate learning and improve memory. Like *Gingko*, *Barcopa* has no known side-effects even at high doses.

Recent work, however, has focused on its free radical scavenging capacity and the protective effect of *Barcopa* on DNA damage. *Barcopa*'s antioxidant capacity may explain, at least in part, its anti-stress, cognitive enhancing and anti-ageing effects.

## Nutrition for Optimum Mental Performance

Clearly the brain needs a number of nutrients including amino acids, fatty acids, vitamins, minerals and herbs if we are to achieve optimal

mental performance. Dosages of the nutrients found to promote optimum brain function vary over a wide range, from doses just above the RDA for nutrients like iron to mega-doses many times above the RDA. For instance, suggested doses for vitamin C is five to 30 times the current RDA of 75mg, while the suggested dose of B6 is 25 to 100 times the RDA of only 2mg.

Now while these doses sound 'high', they are nowhere near levels that may be toxic, which for most vitamins and minerals are between ten to 1,000 times higher than therapeutic doses suggested. Several studies of thousands of people have demonstrated time and again that doses of vitamins and minerals showing therapeutic effects are five to 50 times RDAs, especially in cases of chronic deficiency.

Only people taking unreasonable amounts of vitamins or minerals over long periods of time need be concerned about vitamin or mineral toxicity.

### Synergy: The Missing Piece of the Nutrient Puzzle

What is often overlooked in the suggestions for each of the brain enhancing nutrients above is 'How much do you need when a balanced formula of all relevant nutrients is taken together, including the amino acids, fatty acids and nootropic herbs?' While multi-vitamin and multi-mineral supplements are common, these seldom contain amino acids or fatty acids, and with few exceptions no nootropic herbs.

Most Western studies of supplements only include a single, or at most, two or three nutrients, and thus the amounts found effective and/or recommended only reflect the effects of that specific nutrient. Because nutrients work together synergistically, with one nutrient supporting the function of another nutrient, the amounts of individual nutrients required is often decreased significantly if they are all taken together as a single matrix.

If you really want to enhance your brain function, how do you take more than 20 different vitamins, minerals, amino acids, fatty acids and herbal supplements all at the same time, and in the correct quantities?

This is the role of a nutraceutical designed specifically to enhance mental performance. Nutraceuticals were developed exactly for this reason – that is, to enable the average person to enhance specific functions (such as mental performance) with nutrition, but in a way that was both effective and convenient.

Nutraceuticals are a whole new concept in nutrition. Like pharmaceuticals (which are drugs developed to treat specific diseases and conditions), nutraceuticals are nutritional formulas designed to provide all of the nutrients necessary to optimize particular functions – for instance, one easy-to-take supplement to optimize mental performance, containing a synergistic formula of all relevant nutrients.

Clearly, while many products make claims about their ability to support enhanced brain function, can they deliver what they promise? More importantly, how can you decide which one might work well for you?

With the above considerations in mind, if you wish to 'feed' your brain for optimum mental performance, a good place to start would be to choose a nutraceutical that has the following...:

- Essential Amino Acids for the primary Neurotransmitters in the brain;
- Essential Fatty Acids to support nerve conduction and neuronal membrane stability;
- The correct ratio of Omega-3 fatty acids DHA and EPA with more DHA than EPA, a 3:1 ratio being preferred;
- Adequate levels of most components – that is generally 100% or preferably several times the RDA for that nutrient;
- High quality ingredients and effective forms of the major

components, e.g. chelated minerals, not inorganic minerals like zinc sulfate and calcium carbonate;

- High quality Nootropic Herbs like Gingko, Barcopa and/or Ginseng to enhance brain functions;

...and asks, "do the ingredients demonstrate synergistic effect?" While this is difficult to know from the label alone, if the product meets the rest of the above criteria, there is a reasonable probability that it will be effective.

Many traditional orthodox sources will say that if you eat a balanced diet containing 100% of the RDA of all the major nutrients, then nutritional supplementation is just a waste of money. But, upon what basis do they make this statement?

Certainly this statement is not based upon the scientific literature which demonstrates exactly the opposite for many people who do not possess perfect genes. Nor is it based upon a careful evaluation of the quality of much of the produce and the processed foods actually consumed by many people in Western societies. And it is certainly not based upon the actual food choices many people make, or the junk food industry could not be the multi-billion dollar industry it is today!

However, with today's foods and the food choices we all make, the widespread presence of genetic variation in the ability to absorb and utilize nutrients, and the levels of stress many people in modern societies live with today, it is unlikely that many people will get all of the nutrients they need to maintain optimal mental function from their diet alone. This is especially true when you are under higher levels of stress!

### Foods, Not Specific Nutrients, May Be Key To Good Health

ScienceDaily (Nov. 7, 2007) — In a recent academic review, a University of Minnesota professor in the School of Public Health has

concluded that food as a whole, as opposed to specific nutrients, may be key to having a healthy diet.

This notion is contrary to popular practice in food industry and government, where marketers and regulators tend to focus on total fat, carbohydrate and protein and on specific vitamins and added supplements in food products, not the food items as a whole.

"We are confusing ourselves and the public by talking so much about nutrients when we should be talking about foods," said David Jacobs, Ph.D., the principal investigator and Mayo Professor of Public Health at the University of Minnesota. "Consumers get the idea that diet and health can be understood in terms of isolated nutrients. It's not the best approach, and it might be wrong."

Jacobs, with coauthor Professor Linda Tapsell of the University of Wollongong in Australia, argues that people should shift the focus toward the benefits of entire food products and food patterns in order to better understand nutrition in regard to a healthy human body.

They focus on the concept of food synergy -- the idea that more information about the impact of human health can be obtained by looking at whole foods than a single food component (such as vitamin C, or calcium added to a container of orange juice).

Jacobs and Tapsell provide several examples in which the single nutrient approach to nutrition has not proved to benefit health: Long term randomized clinical trials, considered the gold standard for making judgments about nutritional treatment and health, have failed to show benefit or have suggested harm for cardiovascular events for isolated supplements of beta-carotene and B-vitamins. A similar large experiment in total fat reduction also did not show benefit. In contrast, myriad observations have been made of improved long-term health for foods and food patterns that incorporate these same nutrients naturally occurring in food.

An understanding of the interactions between food components in both single foods and whole diets opens up new areas of thinking that appear to have greater application to contemporary population health issues, particularly those related to chronic lifestyle disease, Jacobs said.

"It is this new understanding that reminds us emphatically of the central position of food in the nutrition-health interface, which begs for much more whole food-based research, and encourages us in both research and dietary advice to, 'think food first'," Tapsell said