The Wise Brain Bulletin

News and Tools for Happiness, Love, and Wisdom

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The Road to (Brain) Health Is Paved with Good Intestines:

How the Gut Affects the Brain through the Immune System

Your gastro-intestinal (GI) system affects the health of your brain through many pathways, including the immune system. The GI system is also a part of the body that it is very easy to intervene with and improve in ways that are natural and beneficial. You might have to make some changes in your diet (and rarely do people really want to do that!), but the results are often dramatic.

So, let's go! Let's find out about this system, its effects on the brain, and how you can help your brain by healing your GI system. The main "side effects" will be that your GI tract will function better in general (e.g., better nutrient absorption, less bloating or constipation).

Modern Challenges to Your Gastrointestinal System

The foods you eat are the primary influences on your digestive system. In this light, consider the multiple ways that most modern humans harm their GI systems. If we use the typical diet of a hunter-gatherer as a guide for what we should eat – which is reasonable because that is what humans and their hominid ancestors ate during millions of years of evolution until agriculture and the domestication of animals for food began just 10,000 years ago – it is easy to see how far we have moved from that diet of wild game and aquatic animals, vegetables, bugs and worms, fruits, nuts, and eggs.

Greetings

The Wise Brain Bulletin offers skillful means from brain science and contemplative practice – to nurture your brain for the benefit of yourself and everyone you touch.

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Rick Hanson, PhD edits the Bulletin, and this issue was designed and laid out by Laurel Hanson.

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Diet and Medication

For starters, compared to a caveman/woman who ate no sugar at all, the average American consumes 158 pounds of sugar per year – that's almost half a pound a day! Junk food made with trans-fats – fats that have been engineered by chemists and are known risk factors for their disease – are commonplace. Many other staples of the modern diet, such as grains and dairy products, were not consumed by our hunter-gatherer great-grandparents.

These nutritional factors interact with human-made chemicals such as pollutants and toxins. Even seemingly benign chemicals in prescription or over-the-counter medications can have worrisome effects on the GI system. Antibiotics, while sometimes life-saving, can dramatically alter the balance of the trillions of bacteria in your intestines by killing off beneficial bacteria and clearing the field for harmful ones. Acid blockers inhibit the first stages of food digestion, leaving particles of food that are incompletely digested to ferment and irritate the intestines. And non-steroidal anti-inflammatory medications like Advil can irritate the tissues of the stomach and intestines, causing ulcers and more subtle changes in the integrity of these tissues, which lead to 100,000 hospitalizations per year in the United States alone. (Wilcox, 2006)

The Double Whammy of Stress

These physical factors interact with psychological factors that are also known to wear on the GI system. A digestive system that's already challenged by mild to moderate chronic stress doesn't need the additional burdens artificial chemicals it hasn't yet evolved to fully handle. And a GI system that's perturbed by the modern diet is less able to handle the daily grind of commuting, multi-tasking, hectic schedules, constant juggling, and endlessly alarming media messages about the larger world. Yikes!

Taken as a whole, you can see how some of the challenges of modern life can gradually wear down your GI system. On the other hand – good news, for once – those multiple negative factors create multiple opportunities for positive intervention.

Individual Variations

People have a wide variety of strength in their constitutions. Some people are like crabgrass and can grow in any environment, but some people are like orchids, and require highly specific and nurturing care to thrive. Orchid-type people are more likely to be affected by, and to feel, the challenges of modern life. Those with a crabgrass-like constitution will be able to endure more before developing or noticing any negative symptoms.

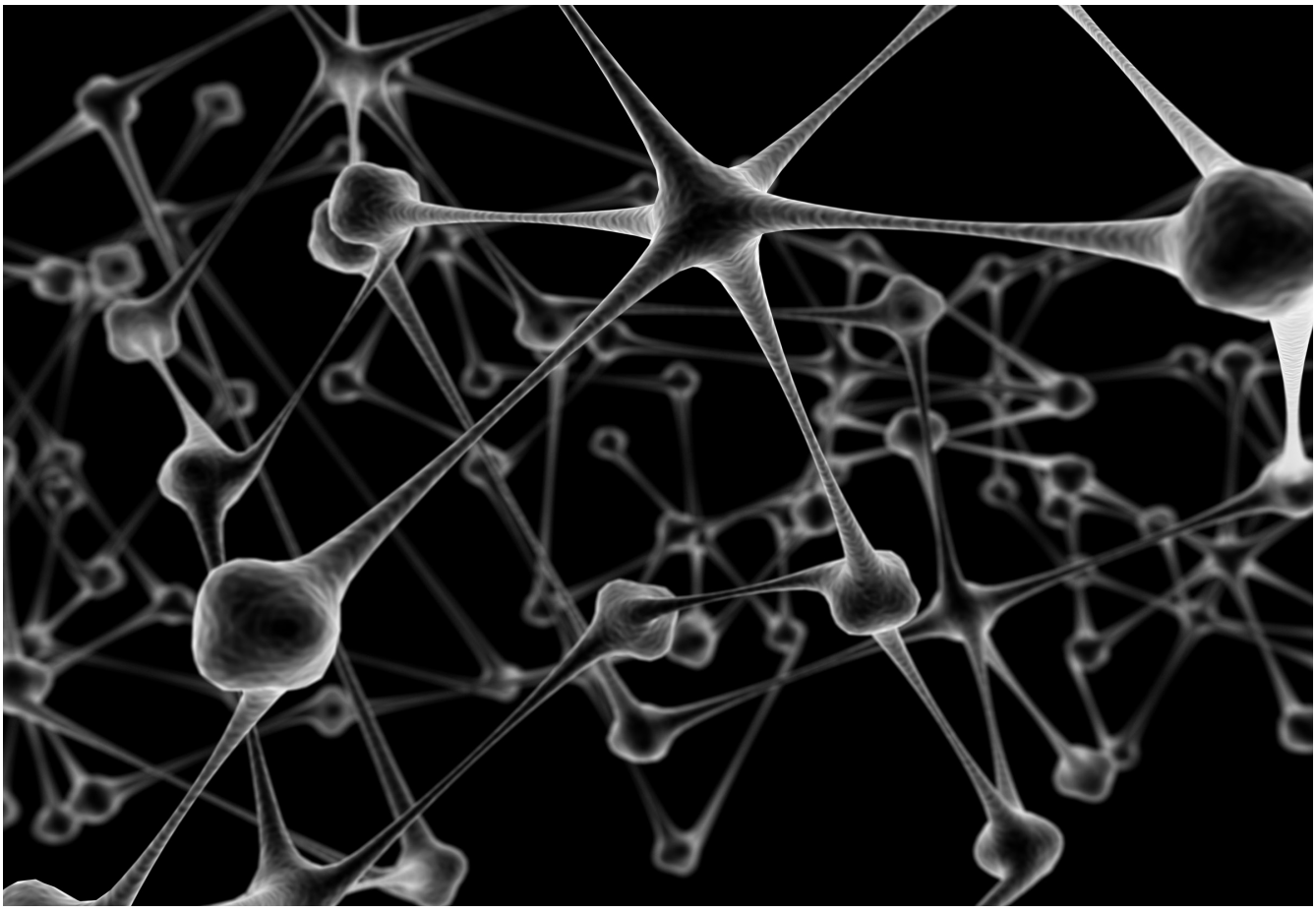
When the Immune System Activates

If the intestines were spread out, and all the little folds were opened, they would cover a surface roughly the size of a tennis court. These intestinal tissues are charged with bringing good molecules into the bloodstream to spread throughout your body, and with keeping bad molecules out. The main way that molecules – the building blocks of life – enter your body (for good or bad) is through your GI system. So it's no wonder that 60-70% of the body's immune system is associated with the digestive tract: the first line of defense for dealing with a foreign invasion of microbes, toxins, or poisons.

This large portion of the immune system in your GI tract is called gut-associated lymphoid tissue (GALT). When GALT is activated, it releases white blood cells to protect against pathogenic invaders. These white blood cells then activate cascades of signaling molecules – called cytokines – that are sent out all over your body.

Cytokines and Their Effects

Cytokines are very important chemical messengers in the body. All immune activations release swarms of cytokines: they are the master controllers of the immune system. Most cytokines create inflammation, though some are anti-inflammatory. You have had the feeling of elevated inflammatory cytokines when you've had the flu: you feel achy and tired, and probably blue or grumpy (or both).



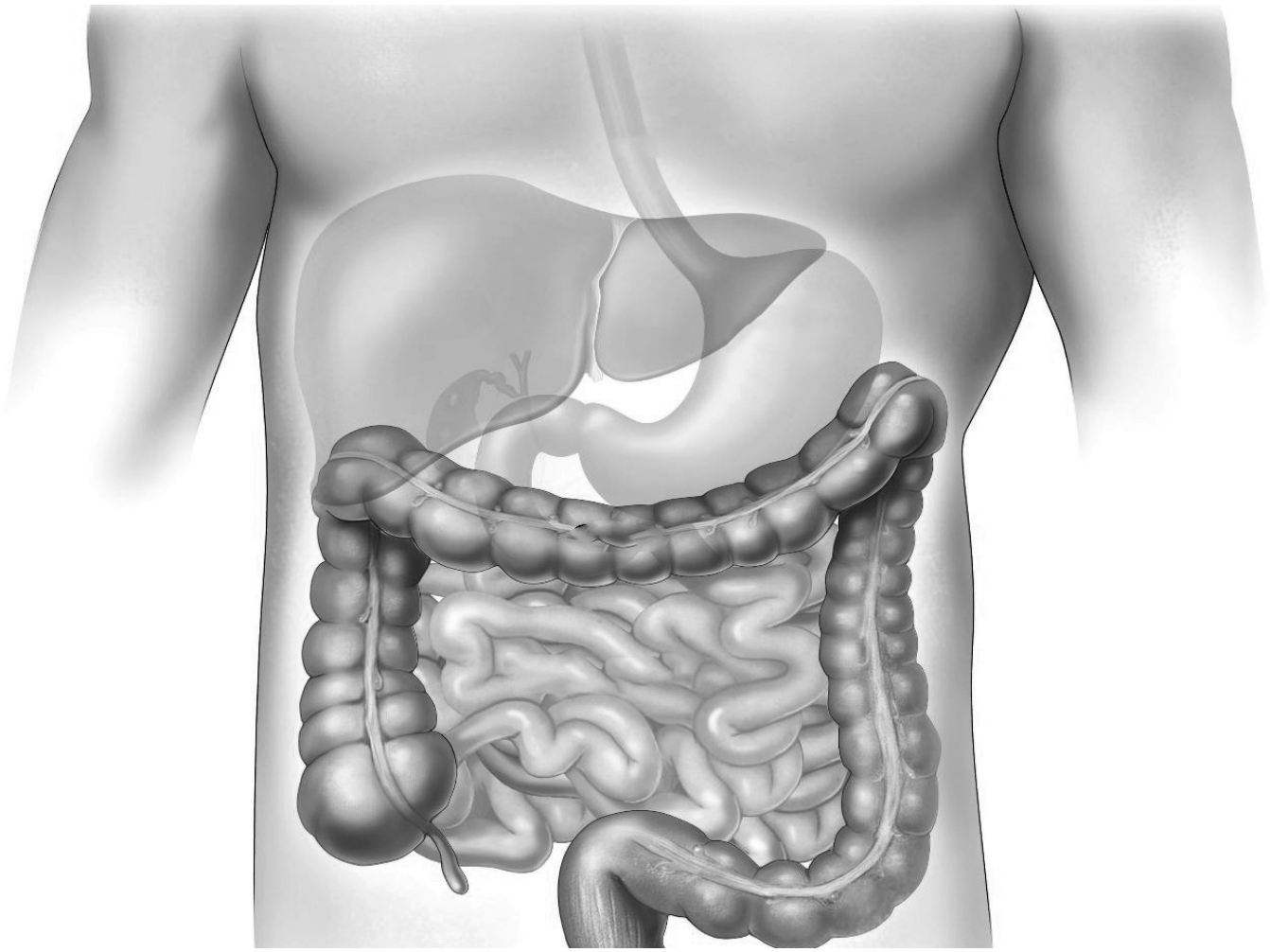
Inflammatory cytokines are useful when the body is fighting an active, acute infection. But they are a problem when they linger. They spread throughout the body, even crossing the protective blood-brain barrier and thus affecting the brain. The result is chronic, low-grade inflammation throughout your body and brain. Inflammatory cytokines can linger in the brain for months, including after the pathogen that originally activated them is long gone.

To give you a prelude of where we are going: when you feel like you have the flu – low energy, little pleasure or interest in things you previously found enjoyable, little appetite, desire for sleep, less resilience, perhaps achy – but do not actually have an active flu virus infection . . . another word for that state of body and mind is depression.

Activating Cytokines

What kind of invaders activate the immune system in your gut (the GALT)?

First, this brilliant system was designed to protect us from inert, non-living, toxic molecules (including strong poisons). As our ancestors evolved over millions, even billions of years, natural toxin protection was very important: nobody was eating out of boxes with FDA-approved labeling. A quick immune response to a bite of not-good-for-me "foreign" molecules could result in regurgitating them to protect



the body. And remember that to a gastrointestinal system that is millions of years in the making, recent modern foods such as wheat, oats, milk, cheese, or soy can seem novel and thus dangerous – triggering a GALT response. (Scott-Taylor, 2010)

Second, the GALT reacts with cytokine releases to problematic microorganisms: both pathogenic ones (e.g., parasites) and overgrowths of microbes that are normally present in relatively small quantities with no ill effects. This issue of immune system reactions to overgrowths applies to yeasts like candida albacans and certain bacteria. (Braat, 2003; Saugusa, 2007)

In a healthy intestine most of the bacteria present are beneficial, or at least neutral. Two well-known strains of beneficial bacteria are lactobacillus acidophilus, and bifidus. In addition to making vitamins and crowding out pathogenic organisms, these bacteria help you by both stimulating anti-inflammatory cytokines and subduing inflammatory ones. (Braat, 2003)

Inflammatory Cytokines in the Brain

Once inflammatory cytokines get to the brain, they cause effects that can lead to neurodegeneration and depressive symptoms.

Depleting Serotonin

First of all, these cytokines affect the transformation of tryptophan (an amino acid) into serotonin (a vital neurotransmitter for well being). Several types of cytokines turn on an enzyme that causes tryptophan, the precursor of serotonin, to break down into other metabolites, thus depleting serotonin.

Toxic Metabolites

Second, some of these metabolites are toxic – 3-OH-kynurenine and quinolinic acid, for you science buffs – and cause oxidation in the brain. Oxidation is a major cause of neurodegeneration, and is linked to multiple neurological conditions, including Alzheimer's disease. These toxic metabolites also cause over-stimulation of certain receptors in the hippocampus, which is a key region for making new explicit and implicit memory, including for positive experiences. This over-stimulation can eventually kill neurons, producing atrophy of the hippocampus; these neural changes are often associated with depression. (Wichers, 2008)

By the way, if you're wondering why we would evolve a health-promoting activation of the immune system that also causes disease-promoting metabolites of tryptophan, you're not alone: some scientists have pointed out that us-

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ing cytokines to deplete tryptophan could help fight strains of pathogenic bacteria that feed on tryptophan. (Yokohama, 1979)

Over-Stimulating the Stress System

Inflammatory cytokines also over-stimulate the adrenal stress system. (Wichers, 2002) This happens through a neural-endocrine pathway called the hypothalamic-pituitary-adrenal (HPA) axis, which triggers a cascade of stress hormones, including cortisol. These hormones are very useful in an emergency – like running away from a lion in humanity's ancient past – but chronic releases of them can be very bad for your long-term physical and mental health. For example, heightened cortisol gradually eats away the hippocampus – degrading memory capacities – plus sensitizes the amygdala (the brain's alarm bell) making you ever more sensitive to stress in a vicious cycle.

Immune System Tolerance

Although people commonly talk about strengthening their immune systems – with this potion or that activity – that's not enough. You also need an immune system that's tolerant: that surely gets activated when needed, but soon returns to normal after the challenge – whether toxin or pathogenic microbe – has been dealt with.

Unfortunately, in the 21st century, ongoing exposure to many kinds of molecules that the body did not evolve to handle over-stimulate the immune system,

which has many consequences, including for the brain. These days, for most people, the key issue is not that their immune system is weak, but that it is – in effect – excited and confused. This problem is similar to what has happened with the neural-endocrine stress response system, which evolved to handle occasional, severe stress. The modern lifestyle – with its widespread combination of chronic, mild-to-moderate stress and tattered networks of social support – over-excites and confuses the body's ancient stress-response systems, harming your health. We need the same thing for both the immune system and the stress-response system: tolerance.

In sum, the gastrointestinal system of many people is continually disturbed by chronic stress, microbial imbalance, and exposures to unwelcome molecules. The results include a chronic state of unwellness, GI inflammation, and continual activation, via the cytokines, of inflammation all over the body. Therefore, it's vital to turn this GI system around, and make it a bastion of immuno-tolerance rather than a troubled swamp of immuno-reactivity.

There are three primary ways to stabilize your GI system and restore appropriate immuno-tolerance:

- Develop a healthy diet.
- Optimize gastrointestinal microflora.
- Optimize your intake of several crucial nutrients.

Taken together these are three great paths toward health in general, and toward protecting and nurturing your brain in particular.

Developing a Healthy Diet

There are two main factors in sculpting a diet that benefits the GI system and the immune system. The first is eating only those foods that promote the healthy balance of the microbes in the intestine. The second is eliminating foods to which you are sensitive, (which activate the immune system in your GI tract).

Eat Good Foods

First, beneficial (and anti-inflammatory) microbes prefer a GI environment that is low in refined carbohydrates and high in fiber, vegetables, protein, fruit, eggs, and nuts. So these foods should form the bulk of your diet, which will also help crowd out foods that are not good for you.

Second, we need to stop eating those foods that are like jet fuel for bad bugs. This means that you must eliminate all (or most, or whatever you can!) sugar and refined carbohydrates (which break down quickly in the body into various sugars). Sugar consumption leads to overgrowths of yeast and bacteria. Try to eliminate sugar in all of its forms, including honey, agave, fructose, maple syrup, molasses, fruit juice, and everything made from white flour. Eat grains mainly in their whole form (e.g., brown rice), not made into flour.

Whew! Some of this may seem shocking. Many people think that agave and fruit juice are just fine. But in fact, they are concentrated forms of sugar. If you want orange juice, it is much better to have an orange – complete with all of its fiber – and a glass of water.

Eliminate Dietary Sensitivities

To the immune system, sometimes even commonplace food molecules are alien intruders that could be hostile. When this natural line of defense overreacts to a food, it's called (depending on some biochemical details) a food sensitivity, allergy, or intolerance; for simplicity's sake, we'll use the term, "sensitivity," to cover all three conditions.

The foods to which people are most often sensitive come from gluten grains (e.g., wheat, oats, rye, barley, spelt, kamut) and dairy products. This makes sense when you consider that these foods were introduced just 10,000 years ago, merely a blip on the evolutionary time scale. People are least likely to be allergic to foods widespread in the caveman/woman diet, such as animal protein, fruits and vegetables, and (gulp) bugs.

So how do you know if you are sensitive to a particular food? One way is to take a blood test that tests for IgG antibodies, which is usually available through integrative health practitioners. Another way is to eliminate suspect foods for a couple of weeks and see if there is a marked improvement. (Once a food has been avoided for at least two weeks, you can also de-

liberately consume it and then see how it affects you.) Additionally, a more informal but often accurate method is to take a pulse reading before eating a food in question and then again 15 to 30 minutes after the food has been consumed; an increase in heart rate of five or more beats a minute could indicate a sensitivity.

Avoiding food allergens can make a dramatic contribution to settling down the immune system of the gut, and therefore decreasing inflammation throughout your body, including your brain.

Try it: see what happens if you make a switch – just as an experiment – to a diet without refined starches (including sugar) and without the two primary allergens, dairy and gluten. Give it two weeks. In my practice people almost always feel much better, their aches and pains decrease or go away, and their digestive tracts usually behave in a much more friendly way. There is a little (at least) emotional withdrawal in the beginning, but most often mood, energy, and mental clarity increase on a food program like this.

Optimizing GI Microflora

The intestines contains trillions of microorganisms, notably bacteria, yeasts, and protozoa such as parasites. It is important to decrease the microbes that activate your immune system, and increase the ones that both strengthen the immune system and make it more tolerant by inhibiting cascades of inflammatory cytokines.

In the case of some microbes – such as parasites and certain bacteria – the aim is to eliminate them entirely. But often it is more a matter of returning to a healthy balance in the ecology of the GI tract, which in most people can do alright with small numbers of problematic microbes. It's like a lawn: a few weeds are inconspicuous and easy to pull, but if the crabgrass takes over, it makes the whole lawn unsightly, plus it's really hard to remove. In the same way, it is overgrowths of various microbes that are the key issue for many people.

Simply by following the healthy diet in the section just above, you will eliminate a primary source of overgrowth of yeast and bacteria: sugar and refined flours. Further, by decreasing the use – when possible – of antibiotics (e.g., looking for alternatives to them to treat minor infections), you will eliminate another source of overgrowth. But many people need even more to balance microflora, settle down the immune system, and help the brain.

Assessment

If you have significant GI symptoms (e.g., bloating, constipation, diarrhea, nausea, queasiness) or otherwise think there could be a real possibility of GI infection (e.g., travel to third world countries), then a comprehensive stool test can be very useful. In my experience, tests from the most experienced labs are usually offered by integrative health practitioners. There has recently been a marked improvement in this

testing, in that it is now possible to use DNA analysis to identify microbes, which is dramatically more accurate than earlier tests.

Treatment

Effective treatment of pathogenic microorganisms in the GI system takes an ecological approach that aims at restoring balance. This is a big topic, but here's a summary.

Kill bad bugs. Antibiotics act quickly and are well-researched, but they are also a big sledgehammer that kills beneficial microorganisms as well as harmful ones. As a result, their use can cause more problems than benefits. Consequently, herbal treatments (e.g., concentrated garlic, emulsified oregano oil) are often your best and most successful option, particularly if your issue is overgrowth of bacteria or yeast. (Hammer, 1999)

On the other hand, if parasites are found through testing, my clinical experience has been that prescription medication is usually needed, and often over longer treatment periods than are commonly used. Be sure to work with an experienced practitioner if you find parasites. Eliminating parasites often has dramatic effects, and it's worth doing well.

Add good bugs. Almost everyone will gain from adding probiotics – beneficial bacteria – to their diet. These strains in particular have good research data indicating that they promote immune tolerance (McCarthy, 2003):

1. *Lactobacillus GG, (Culturelle)*
2. *Lactobacillus salivarius*
3. *Bifidobacterium bifidum* (particularly for young children, or for those who took lots of antibiotics during childhood)
4. *Sacromyces boulardi* (Florastor)

These probiotics can often be found in mixtures. All except Sacromyces are bacteria that are usually very easy to get used to, with only beneficial effects. Sacromyces is a beneficial yeast that is very useful, but can also take time to get used to, so always start slowly with it, with a half capsule for several days. Then take several more days to increase to one to two capsules a day.

Nutrients for Immuno-Regulation

Many nutrients support the immune system; I will focus here on three of the most important ones for immuno-regulation: vitamin A, vitamin D, and Omega-3 essential fatty acids. While these nutrients are of course available in food, it is difficult if not impossible to consume the beneficial levels described here through any method other than through taking supplements.

Vitamin A

Vitamin A supports immune cells in the GI tract that promote regulation – a form of tolerance – within the immune system. (Seung, 2007) I recommend a modest dose, 5000 I.U. per day, which is considered safe for everyone. Some may get added benefit from taking 10,000 I.U. per day, but pregnant women, or women who could become pregnant within a few months, should stick to the 5000 I.U. Check the label and take "pre-formed vitamin A" rather than beta-carotene, since beta-carotene is not effective for this immune-related function.

Vitamin D

Vitamin D is a strong modulator of the immune system, and reduces inflammation. (NIH) Typically, supplementing 2000 I.U.'s a day of vitamin D is appropriate, but the best way to determine the proper dose for you is to have your vitamin D checked. The marker for vitamin D, called 25-OH-vitamin D, should be around 50 ng/ml. Your doctor can order this particular test. There is a complex interaction between vitamin A and D, and vitamin D levels should be supported – as described in this paragraph – when supplementing Vitamin A.

Omega-3 Fish Oil

Omega-3 fish oil is a known modulator of the immune system, and it reduces inflammation through several pathways, including by suppressing inflammatory cytokines. Additionally, the oils present in fish oil make up a large portion of the fats in your brain. The benefits of omega-3 oils are enormous, from lifting depression to decreasing cardiovascular disease. Take enough highly purified fish oil to get at least 500 mg./day of both DHA (decosahexaenoic acid) and EPA (eicosapentaenoic acid). (Kang, 2008) If you are a vegetarian, you can get some benefit from a combination of flax oil and DHA from algae, but using fish oil is the most effective way to get omega-3 oils into your body.

Closing Thoughts

We've covered a lot of ground, and I'm glad you stayed with me on this journey!

Four Basic Steps

Here are the four steps you can take to improve the functioning of your gastrointestinal system, with particular attention to reducing immune reactions that wear on the brain:

1. Move to a diet that's low in refined sugar and carbohydrates as well as free of food allergens.
2. Remove any pathogenic organisms such as parasites, and reduce any problematic overgrowths of yeast or bacteria; testing from a good lab can be very clarifying.
3. Take beneficial probiotics.
4. Supplement with vitamin A, vitamin D, and fish oil.

Two Cases

When you clear up problems in the GI tract, remarkable things can happen to mood, behavior, and mental clarity. Here are a two examples from my practice.

I once worked with a young boy who had several significant behavior problems that led to innumerable time-outs, along with much stress for him and his parents. Using food allergy blood testing, we found a number of foods – primarily those made from gluten – that his immune system was sensitive to. Consequently, the family instituted a diet that eliminated those foods. Some of these – such as cookies

and crackers made with wheat – were among his favorites (often people crave the foods that they are sensitive to), so his family had to be extra nurturing during this transitional period. But very quickly, over just a week or so, his happy mother reported to me that when he was following his diet, he was as reasonably well-behaved as any six-year-old should be; no time-outs were necessary. Yet when he was allowed to veer from his diet, his behavior immediately shifted, and he'd need several time-outs each hour.

In another case, an adult man had had chronic mild depression and what he called "mental fog" for many years. He was just in his thirties, and wasn't expecting cognitive decline yet! By doing some laboratory testing, we discovered that he had an overgrowth of a problematic bacteria in his intestine, and we began treating it with aggressive probiotic treatment. It took a few weeks, but then he reported to me that his mind had snapped into focus, and for the first time he was as clear as he had been when he was in college. His depression also lifted. He maintained the clarity by supporting his GI health in the ways I've recommended in this essay.

The Gut and the Brain

From my earliest days in practice, I've been struck by the major improvements in mental health that routinely result from optimizing the GI system, with no other physical interventions.

Everyone who wants to support their brain health should take good care of their GI system. Similarly, anyone with an inflammatory issue – whether chronic headaches or back pain (which often have an inflammatory component), arthritis, or cardiovascular disease – should work on their gut. It is both a major source of inflammation in the body and brain, and a bodily system that you can really improve. It's hard to change the air we breathe, which also has toxins that stimulate inflammation. But you can change your GI system: you can control what you eat and take the other steps reviewed here. Everyone can dramatically improve this system.

As a result, you will help relax the burden on your immune system. The inflammatory cascade will decrease, and you will develop a more tolerant immune system. Your brain will have a reduced load of inflammatory cytokines, which will tend to increase serotonin and decrease cortisol and other stress hormones. Additionally, a GI system in good order will help your body absorb all of the nutrients your brain needs. And just think, as a side benefit, you will probably lose some weight.

To your health!

Perspectives on Self-Care

Be careful with all self-help methods (including those presented in this Bulletin), which are no substitute for working with a licensed healthcare practitioner. People vary, and what works for someone else may not be a good fit for you. When you try something, start slowly and carefully, and stop immediately if it feels bad or makes things worse.

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Even in the Struggle

Even in the struggle, you are loved.
You are being loved not in spite of the hardship, but through it.
The thing you see as wrenching, intolerable, life's attack on you,
is an expression of love.

There is the part of us that fears and protects and defends and expects,
and has a story of the way it's supposed to turn out.
That part clenches in fear, feels abandoned and cursed.

There is another part, resting at the floor of the well within, that understands:
this is how I am being graced, called, refined, by fire.
The secret is, it's all love.
It's all doorways to truth.
It's all opportunity to merge with what is.
Most of us don't step through the doorframe.
We stay on the known side.
We fight the door, we fight the frame, we scream and hang on.
On the other side, you are one with the earth, like the mountain.
You hum with life, like the moss.
On the other side, you are more beautiful:
wholeness in your bones, wisdom in your gaze,
the sage-self and the surrendered heart alive.

Tara Sophia Mohr

http://wiselivingblog.com/2010/07/even-in-the-struggle

Tara Mohr is a writer, coach, and the creator of Wise Living, which offers tools for living with greater fulfillment, peace and everyday joy.

Fare Well

May you and all beings be happy, loving, and wise.