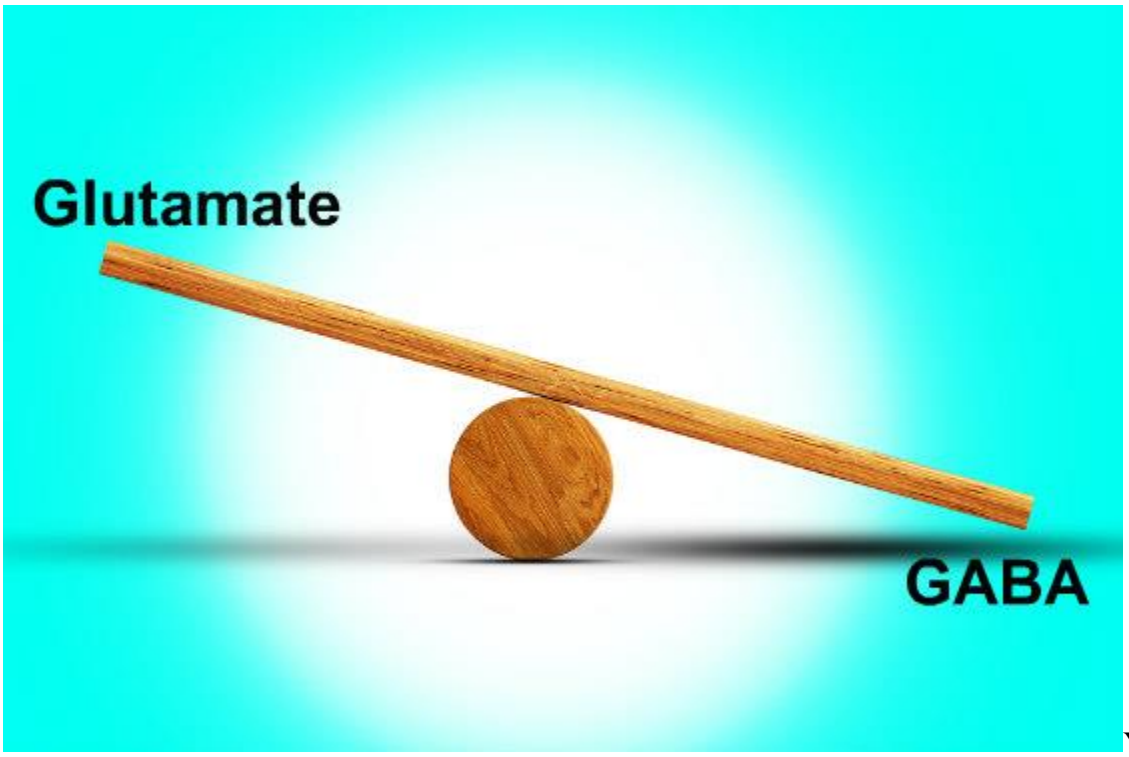
How to Increase GABA and Balance Glutamate

by Admin - Cynthia Perkins on May 28, 2014



You can't really talk about how to increase GABA without talking about glutamate, because they have a complex and interconnected relationship. Both are very important neurotransmitters that have a profound impact on many different aspects of our physical, mental and spiritual health with the former being inhibitory and the latter being excitatory. Excitatory neurotransmitters stimulate brain cells, while inhibitory ones reduce stimulation**. Like all neurotransmitters, too much or too little of either one leads to problems.**

When all is working as it should, they keep each other in balance. However, there are many factors that can easily disrupt this delicate balance and result in too much glutamate and not enough GABA, which can wreak havoc on your mental and physical health.

What is Glutamate?

Glutamate is one of your primary excitatory neurotransmitters. It has many important roles like stimulating your brain cells so you can talk, think, process information, learn new information, pay attention, and store information in short and long term memory. As a matter of fact, studies suggest that the more glutamate receptors you have the more intelligent you are. High levels of

glutamate receptors are correlated with superior abilities in learning and memory. Unfortunately, they also correlated with an increased risk of stroke and seizures.

Although glutamate is one of the most abundant neurotransmitters found in the brain, it exists in very small concentrations. If the concentration level rises, then neurons become too excited and don't fire in a normal manner. Glutamate becomes an excitotoxin when it is in excess; meaning it overstimulates brain cells and nerves and results in neurological inflammation and cell death.

An excess of glutamate is a primary contributing factor to a wide variety of neurological disorders like autism, ALS, Parkinson's schizophrenia, migraines, restless leg syndrome, Tourette's, pandas, fibromyalgia, multiple sclerosis, Huntington's chorea, and seizures. As well as atrial fibrillation, insomnia, bedwetting, hyperactivity, OCD, bipolar disorder, anxiety disorders, and STIMS (repetitive self-stimulatory behaviors like rocking, pacing, body spinning, hand-flapping, lining up or spinning toys, echolalia, repeating rote phrases or other repetitive body movements or movement of objects that are commonly seen in autistic children) and an increased risk of stroke.

Too much glutamate can also increase eosinophils (a particular type of white blood cell) which result in inflammation, impair blood vessels that lead to migraines and blood pressure irregularities, and impair other areas of the brain like the hypothalamus, hippocampal neurons, and Purkinje neurons which affect speech and language.

Mercury in the body becomes more toxic in the presence of high levels of glutamate.

Excess glutamate also makes cancer cells proliferate and increases tumor growth and survival.

Elevated levels of glutamate trigger the brain to release its natural opioids (endorphins/enkephalins) in order to protect the brain from damage, which can result in feelings of spaciness and eventually contribute to depletion of your natural opioids, and it also depletes glutathione levels, which is vital for detoxification, controlling inflammation and gut health. Additionally, glutathione also assists in protecting neurons from damage, so when it is depleted it is not available to do this job and thus contributes to more cell death.

High levels of glutamate may increase the survival of unfriendly microbes in the gut and contribute to problems like excess acid and heartburn.

Too much glutamate can lead to too much acetylcholine, and too much acetylcholine has a stimulating effect as well and puts one into a perpetual state of sympathetic stress with high levels of anxiety, fear, insomnia, restlessness, nervousness etc.

What is GABA?

GABA, which is short for gamma-aminobutyric acid, is your primary inhibitory neurotransmitter. **Its primary role is to calm the brain, slow things down and relax you.** One of the ways that it assists in this process is by increasing alpha wave production. It is also vital in

speech and language. GABA puts the pause or space between words when you speak. The brain uses it to support sensory integration. Without adequate GABA production, our conversations would consist of lots of run on sentences, slurred speech or loss of speech, and we would have trouble with comprehending language.

Your gastrointestinal tract is packed with GABA receptors and it is critical for contraction of the bowel. Insufficient levels can result in abdominal pain, constipation, and impaired transit. It also supports healthy levels of IgA, (antibodies that protect your gut and other mucous linings from harmful invaders) which means it contributes to immune health.

Insufficient levels of GABA result in nervousness, anxiety and panic disorders, aggressive behavior, decreased eye contact and anti-social behavior, attention deficit, problems with eye-focusing (like that seen in autistic children when both eyes are focused inward towards the nose or waver back and forth in a horizontal or vertical movement), chronic pain syndromes and much more. It may also contribute to GERD as it is needed to help regulate the lower part of the esophagus.

Low levels of GABA play a vital role in alcoholism, drug addiction, and cravings for sugar and carbs, as these substances will temporarily and artificially increase GABA, so one is unconsciously drawn to them. However, these substances also deplete neurotransmitters, so they will perpetuate the problem.

Gamma-aminobutyric acid is found in almost every area of the brain, but the hypothalamus contains a very high level of GABA receptors, so it is vital for its many functions like regulating sleep, body temperature, appetite, thirst, sexual arousal and desire, and action of the pituitary, HPA axis, and the autonomic nervous system. The primary role of the hypothalamus is to maintain homeostasis throughout the body, and without enough GABA production, this will not happen.

Like all neurotransmitters GABA and glutamate play a vital role in regulating the autonomic nervous system (stress response system), maintaining the balance between the sympathetic and parasympathetic nervous systems. Too many excitatory neurotransmitters and we are in sympathetic nervous system mode and not enough inhibitory and we are unable to return to the parasympathetic mode. Thus, depletion of GABA can be a major contributing factor to autonomic nervous system disorders of all kinds like adrenal fatigue, insomnia, chemical sensitivities, chronic fatigue, panic attacks, etc. Maintaining sufficient levels is crucial in the recovery of these conditions.

GABA and Glutamate Balance

When GABA is low, glutamate is high and vice versa. So in order to increase gamma-aminobutyric acid, it’s not simply a matter of bringing it up, you must also focus on reducing the excess glutamate. The goal is to achieve balance between the two. You might think of glutamate as the accelerator and GABA as the brakes. Both are equally important.

Glutamate (also referred to as glutamic acid) is actually the precursor to gamma-aminobutyric acid, and any excess is supposed to be converted automatically into GABA. This is the way it maintains balance; anytime glutamate levels start to build up too high, then it is converted to GABA to calm things down. However, sometimes the body cannot regulate glutamate properly for a variety of reasons which we will discuss, then glutamate can build up to excessively high levels.

An enzyme called glutamic acid decarboxylase (GAD) is needed for glutamate to make the conversion to GABA, but there are several factors that may interfere with this enzyme and impede the conversion process, which means a build up of glutamate and inhibited the formation of GABA. Response time may be delayed or capacity to convert may be impaired. **It is believed that problems with the GAD enzyme may be the primary underlying issue that results in too much glutamate.**

For example, the rubella virus, which is found in the MMR vaccination can decrease the activity of glutamic acid decarboxylase (GAD)by as much as fifty percent. Thus, one of the reasons children begin to exhibit some of the symptoms of autism immediately after vaccination, as we mentioned earlier GABA is critical in speech and brain function.

Other chronic viral infections interfere with the GAD enzyme and some microbes like streptococcus flourish in a glutamate-rich environment, thus many children with pandas and autism carry an ongoing infection with strep.

Methylation also plays a role in the GABA and glutamate balance in a variety of ways. For one, if there is impairment in the methylation pathway, then folate doesn't get utilized and it can break down into glutamate. Additionally, if you are not methylating properly you may not be able to suppress microbes like viruses or make enough T cells to fight them off, which means they will linger around to interfere with the GAD enzyme.

Methylation may be impaired due to nutritional deficiencies, toxins, genetic mutations, or Candida overgrowth. Methylation is also heavily influenced by the Krebs cycle and vice versa, so a problem in this cycle can also impede methylation, and consequently GABA production. The Krebs cycle can also be impaired by Candida overgrowth, as well as bacterial overgrowth. If methylation is impaired, then it is even more important to manage glutamate levels.

Additionally, the syntheses of GABA itself is also dependent on the Krebs cycle, so it is vital in more ways than one that this system be working properly to have sufficient levels. The Krebs cycle can become impaired in a variety of ways like a deficiency in B vitamins or the presence of heavy metals, and toxins from bacteria or Candida.

The GAD enzyme is generated by the pancreas, so problems with the pancreas may impair production of the enzyme.

People with type 1 diabetes produce antibodies against the GAD enzyme, which may impair its response time or ability to convert.

Lead also interferes with GAD activity. Lead also inhibits another enzyme involved in the heme synthesis pathway which results in an accumulation of an intermediate that competes with GABA.

Some substances like allylglycine (a derivative of glycine) are potent inhibitors of GAD.

B6 is also needed as a cofactor with GAD to convert glutamate into GABA, so if B6 levels are not sufficient, the conversion won't happen either. Much of the population is deficient in B6.

Additionally, glutamate receptors also pull in other excitatory substances into the cell beside glutamate, including all of the following:

- Aspartate (can also be converted into glutamate)
- Aspartame
- Aspartic acid
- Glutamate
- Glutamic acid
- Glutamine
- Monosodium glutamate (MSG)
- Cysteine (But not n-acetyl-cysteine. However, does contain sulfur and too much sulfur can be counterproductive as well, so should be used mindfully.)
- Homocysteine

Therefore, each of these can bind with glutamate receptors, which also results in excessive stimulation and contributes to the imbalance in GABA and glutamate and the wide array of symptoms that are generated. The more glutamate receptors you have the more excitatory substances that will be pulled in.

Citrate or citric acid has the potential to be neurotoxic in the very sensitive because most citrate is derived from corn, which can result in trace amounts of glutamate or aspartate during processing.

To **complicate things further, glutamate has the ability to bind with six other receptors in the brain,** like the NMDA receptor, which assists in delivering calcium to the cell and plays a vital role in memory function and synaptic plasticity. Calcium is used by glutamate as the agent that actually inflicts the harm on the cell. So, if there is an excess of calcium in the body for any reason, it too will contribute to the GABA and glutamate imbalance.

Glutamate and calcium together cause ongoing firing of the neurons, which triggers the release of inflammatory mediators, which leads to more influx of calcium. It becomes a vicious cycle that results in neural inflammation and cell death. Glutamate has been described as the gun, while calcium should be seen as the bullet, says Dr. Mark Neveu, a former president of the National Foundation of Alternative Medicine. It's important to note that activation of the NMDA receptor also involves glycine, D-serine or D-alanine, which means either one of these could allow for more influx of calcium as well.

Magnesium will help regulate calcium levels and so can zinc. However, higher doses of zinc (more than 40mg per day) can also activate the release of glutamate through non-NMDA glutamate receptors, so one must exercise caution with zinc. However, if calcium is excessively high, other herbs or nutrients may be used to bring it down, like lithium orotate, Boswellia or wormwood. Lithium, as well as iodine and boron, can also assist in lowering glutamate. Calcium intake in food may need to be reduced or limited if calcium is too high. Magnesium is also able to bind to and activate GABA receptors.

If one exhibits low levels of calcium, Dr. Amy Yasko recommends using nettle or chamomile to increase calcium levels, rather than supplementation of calcium itself, if we are dealing with someone who has an imbalance in GABA and glutamate. Vitamin K & D would be important as well. If supplemental calcium is used it should be accompanied by magnesium, which will help control the excitotoxic activity.

Glycine can be inhibitory or excitatory, and in people who tend to lean towards excess glutamate it typically becomes excitatory, so it may need to be avoided.

Glutathione contains glutamate, so supplementing too heavily may contribute to excess glutamate.

Vitamin D increases calcium levels, and as we established, elevated calcium levels can increase glutamate, so caution may be necessary with vitamin D supplementation.

T**he amino acid taurine increases the GAD enzyme and consequently GABA levels.** Additionally, taurine doubles as an inhibitory neurotransmitter and can bind directly to GABA receptors, so it can help provide balance naturally in that manner as well. Higher levels of any inhibitory neurotransmitter help lower high levels of any excitatory neurotransmitter. Taurine is found in high levels in the brain and cardiac tissue, indicating its importance in these areas. Taurine is found most abundantly in seafood and animal protein, so it is often deficient in one's diet.

If taurine is deficient, then the GAD enzyme may be low as well, therefore, supplementing with taurine can be used to manage the GABA and glutamate balance and protect from neuron death. However, there are a couple genetic polymorphisms (particularly CBS and SUOX gene mutations) that can result in negative effects from taurine supplementation, because these mutations result in excess levels of sulfur in the body and taurine is sulfur based. If one has these gene mutations, they may also need to avoid other supplements that are high in sulfur and limit sulfur based foods. These mutations can also impair ammonia detoxification as well. B6 and SAMe increases the activity of these gene mutations, so supplementation with these substances may compound the problem too. Because of the GABA shunt, which can convert GABA back into glutamine, which is then converted into glutamate, taurine supplementation may increase glutamate in some people.

Additionally, Candida produces a toxin called beta-alanine that competes with taurine for reabsorption in the kidney, and causes taurine to be wasted in the kidneys and excreted through the urine and beta alanine is absorbed instead. Therefore, taurine levels may be insufficient,

which can contribute to less GABA activity. Not only that, taurine can combine with magnesium to form magnesium taurate and the two of them may be eliminated together, which can lead to magnesium deficiency. Insufficient levels of magnesium are going to result in excessive levels of calcium, which as we established earlier, will increase glutamate firing.

Serotonin, another vital inhibitory neurotransmitter is also needed in order for GABA to work properly. If one is deficient in serotonin, then even if you have sufficient levels of gamma-aminobutyric acid, it may not be able to perform its inhibiting effects adequately.

A diet that does not contain enough of the nutrients needed to make inhibitory neurotransmitters like animal protein and fat plays a vital role in an imbalance between glutamate and GABA. Furthermore, proper transmission of any neurotransmitters can't happen without adequate levels of fat and most people are not consuming enough fat in their diet. Additionally, many foods and substances like sugar, whole grains, any high starch food, caffeine, chocolate, artificial sweeteners and flavorings, food additives and dyes can deplete GABA levels or disrupt transmission, so they should be removed from the diet. Grains (including whole grains) can bring about an excitotoxic effect by causing excessive glutamate formation in some people.

A ketogenic diet has been found to favor GABA production and be exceptionally beneficial in the treatment of many conditions associated with excess glutamate like seizures and epilepsy. A ketogenic diet increases the GAD enzyme and neurons can use ketones produced from ketosis as a precursor to GABA. Additionally, glutamate can be turned into GABA or aspartate. Aspartate is also an excitotoxin in excess, with similar effects as elevated glutamate. A ketogenic diet encourages glutamate to become GABA, rather than aspartate. **Therefore, following a low-carb keto/ Paleo diet would be the ideal diet for maintaining balance between gamma-aminobutyric acid and glutamate.** You may want to note, that some fish like mackerel have high levels of naturally occurring GABA

Environmental toxins like pesticides, herbicides, air pollution, heavy metals, and chemicals found in your common everyday household cleaning products, cosmetics, perfumes and colognes, air fresheners, personal care products, dish soap, laundry soap and fabric softeners, **all deplete and disrupt normal production and function of all neurotransmitters.** Therefore, another critical component for maintaining sufficient levels of GABA is to reduce your exposure to these toxins by living an environmentally friendly lifestyle and eating organic.

Supplementing with GABA is a popular suggestion among many practitioners. However, I frequently work with people who get a stimulating effect from supplementation and I get a stimulating effect myself, so be sure to monitor your response. GABA itself can be converted back into glutamine, which is then converted back into glutamate through a metabolic pathway called the GABA shunt. So GABA supplementation can end up increasing glutamate in some people as well.

According to Dr. Datis Kharazzian, a brain expert, if you have any effect from GABA, (positive or negative) that means you have a leaky brain. In his book, *Why Isn't My Brain Working*, he explains that in a healthy brain, the junctions in the blood-brain barrier only permit nanoparticles to pass through. GABA "exceeds the nanoparticle size and does not have a blood-brain barrier

transport protein." It should not be able to cross the blood-brain barrier. If it does, then this suggests there is leaky brain.

As a matter of fact, Dr. Kharrazian uses GABA supplementation as a screening tool to determine whether one has a leaky brain or not, calling it the GABA Challenge Test. He also states you shouldn't take GABA supplementation, even if you have a positive effect, "because you risk shutting down your GABA receptor sites." If you have no effect from GABA, this is good sign, you most likely to do not have leaky brain.

The toxins created by Candida can stimulate surges of glutamate production. Hundreds of other toxins can produce this same surge in glutamate activity, including mold toxins, bacterial toxins, Lyme, and organic solvents. Dr. Rick Sponaugle, a brain expert, states that even the toxins released by bacteria in your mouth that cause gingivitis and periodontal disease can increase glutamate activity and lead to a wide array of symptoms like anxiety. I can attest to this personally, I have experienced high anxiety from a bout with gingivitis. So it's important to note, that many of the symptoms of Candida overgrowth can be caused by caused by an excess of glutamate.

Glutamate and insulin have an intimate relationship. On one hand, high glutamate will trigger the release of insulin, which means insulin will then lower glucose levels; but glucose is needed to help regulate glutamate levels at the synapses, so if it goes to low, then glutamate is going to increase. This means hypoglycemia or low blood sugar will result in both triggering high levels of glutamate and impairing your ability to reduce the build up.

Therefore, not eating foods that spike insulin and keeping blood sugar levels stable are a vital element of keeping glutamate and GABA in balance. At the same time, keeping your glutamate balanced would be a vital aspect of keeping your insulin levels healthy, which would be important if you are trying to lose weight, have insulin resistance, type 2 diabetes, compulsive overeating, obesity, and the many other insulin-related conditions. Again, demonstrating how the Paleo diet would be the most beneficial diet for this issue.

Some people have a genetic mutation (VDR/Fok gene) that impairs their ability to regulate their blood sugar levels sufficiently. Dr. Amy Yasko, says there are a variety of pancreatic supplements that may be needed to support this issue.

There are many drugs that target your GABA receptors like Ativan, Xanax, Klonopin, Valium, and Neurontin (Gabapentin) and others. These drugs look similar in chemical structure as gamma-aminobutyric acid so they can fit in your GABA receptors, which artificially stimulates them, but they do not actually increase production. Therefore they do not address the underlying problem of not producing enough because there must be some level of GABA present in order for these drugs to have an effect. Furthermore, anytime a substance is used to artificially stimulate a neurotransmitter the brain responds by reducing production or responsiveness, which results in more depletion of the neurotransmitter, which in this case is GABA. Therefore, any drugs that target GABA receptors or manipulates GABA or glutamate, will inhibit your ability to acquire and maintain balance.

Some people may have a genetic predisposition to have more glutamate receptors than others, and the more glutamate receptors you have, the more you will take in. In this case, you will likely be someone who always tends to lean toward excess glutamate activity and will need to engage in life-long ongoing monitoring and maintenance to prevent overstimulation, cell death, and neurological symptoms. However, if there is excess glutamate in the system due to genetic mutations, methylation problems, etc., then more glutamate receptors will be generated as well.

As is true for all neurotransmitters, ensuring that you get adequate sleep is vital for normal function because sleep deprivation causes neurons to lose sensitivity to neurotransmitters, thus impairing communication.

Excitotoxins in the Diet

One of the biggest contributors to an imbalance in GABA and glutamate is the presence of excitotoxins in the diet. Many foods and nutritional supplements contain the excitotoxins (glutamate, glutamic acid, glutamine, aspartate/aspartic acid, and cysteine) or they contain substances that can prompt the body to produce them. These foods and substances should be avoided by anyone trying to balance their GABA and glutamate levels and anyone who tends to generally lean towards excess glutamate.

Dr. Amy Yasko explains that "**excitotoxins in food overexcite neurons to the point where they become inflamed and begin firing so rapidly they become exhausted or die**." This results in a wide array of neurological symptoms that are found in autism, OCD, anxiety disorders, insomnia, hyperactivity, attention deficit, nervousness, aggressive behavior, restless leg syndromes, Tourette's, migraines, seizures, and more. Excitotoxins increase other excitatory neurotransmitters as well like norepinephrine, which compounds these symptoms.

Dr. Amy Yasko, an expert in autism, tells parents with children who have autism that if they take only one step in her recovery program that the most important element is to eliminate excitotoxic foods that increase glutamate levels. This one step alone can provide dramatic improvements in STIMS. Thus, demonstrating the profound impact that excitotoxins have on brain function.

Most Common Sources of Excitotoxins

Monosodium glutamate. Keep in mind that MSG is found in numerous places you may not be aware of like most processed food, fast food restaurants, and it may be a binder in medications, supplements, prescription drugs, over the counter drugs, IV fluids, vaccines, and as a growth enhancer sprayed on crops of food and produce called Auxigrow.

Aspartame (Nutrasweet)

Glutamate and aspartate are naturally occurring in wheat gluten, hydrolyzed yeast, and milk casein (which means any dairy product that contains casein has the potential for problems, but particularly cheese, which is a concentrated form of casein).

Other common food sources that contain excitotoxins include, hydrolyzed protein, hydrolyzed oat flour, or anything hydrolyzed, sodium caseinate, calcium caseinate, disodium caseinate, autolyzed yeast, yeast extract or anything else autolyzed, gelatin, glutamic acid, carrageenan or vegetable gum, guar gum, bouillon, kombu extract, anything malted, maltodextrin, many seasonings and spices, soy extract, soy protein or soy protein concentrate, or soy protein isolate, and soy sauce, textured protein, whey protein, whey protein concentrate or isolate.

The words natural flavor or natural flavoring on a package typically means it contains MSG or some other excitotoxin because they are used to stimulate your taste buds and artificially intensify the flavor.

Other foods or substances that contain excitotoxins and can damage nerves include anything fermented, protein fortified, or ultra-pasteurized, or vitamin enriched, corn syrup, body builder formulas or protein formulas, caramel flavoring or coloring, flowing agents, dry milk, L-cysteine, egg substitutes, cornstarch and some brands of corn chips, citric acid if it is processed from corn, certain brands of cold cuts, hot dogs and sausages (even the ones in health food stores), many canned foods, pectin, pickles, any processed food, meats in mainstream grocery store are often injected with them, tofu or other fermented soy products, xanthan gum or other gums.

Any nutritional supplement that contains glutamine. Glutamine is often recommended to heal the gut and increase GABA, but it first increases glutamate, and if you aren't converting your glutamate to GABA for any of the many reasons we listed above, then you end up with nothing but a bunch of excess glutamate. Anyone who has an issue with excess glutamate should avoid supplementation with glutamine. Glutamine and glutamate convert back and for into one another.

It can also be a matter of potency. For example, I can consume yogurt or butter every once in a while with no glutamate problems, but if I consume whey protein then I have immediate excess glutamate. This is because the level of glutamate in whey protein is much more concentrated than it is in butter or yogurt. Anything that has a concentrated level of glutamate is going to be more problematic than something that has less potency.

Bone broth, which is commonly recommended for healing the gut is very high in glutamate, especially chicken bones. For example, I get an instant migraine from taking a little sip of bone broth from the glutamate content. I can't even cook chicken with the bone, or the chicken will absorb the glutamate and give me a migraine. I can sometimes eat beef or buffalo cooked with the bone, but it varies. I do best if the bone is removed. So you should experiment to see if your meat cooked with bone is contributing to your glutamate imbalance and be aware that bone broth will increase your glutamate levels. Just slow cooking meat for a long time, particularly braising, can increase glutamate.

Some common foods that are particularly high in glutamate are parmesan cheese, Roquefort cheese, tomato juice, grape juice, and peas. Walnuts, mushrooms, broccoli, tomatoes, and oysters are moderately high as well. Chicken and potatoes to a much lesser degree. If you eliminate all the other high glutamate substances, then you may not have a need to reduce some of these health-enhancing foods like broccoli, walnuts, and chicken. However, if your glutamate levels

are really elevated, then these foods may be problematic as well, at least until you get levels reduced to some degree.

Protein powders, amino acid formulas, and collagen are high in glutamate. Branch chained aminos (leucine, isoleucine, and valine) taken in high concentrations can be excitotoxic.

Other Contributing Factors to Imbalance

You may also have a genetic polymorphism that inhibits your ability to form GABA itself. When that is the case, then supplementation may be needed ongoing.

Pyroluria is a genetic problem in hemoglobin synthesis that can result in deficiencies in B6 and zinc, both of which are critical for the production of GABA or the management of excess glutamate. Therefore, if you have pyroluria it can indirectly contribute to a GABA and glutamate imbalance.

Chronic stress is a major contributing factor to depletion of GABA and other inhibitory neurotransmitters. High levels of inhibitory neurotransmitters like gamma-aminobutyric acid and serotonin are needed to modulate the stress response system. They help the mind and body return to the parasympathetic state when the stressful event is over. If the stressful event is never over, then they are called upon repeatedly and over time this will drain their levels. Therefore, managing chronic stress is a vital element for the GABA and glutamate balance.

Childhood abuse or trauma alters GABA receptors, resulting in less GABA function, and this is carried with the survivor into adulthood. Survivors of abuse also have lower levels of serotonin and dopamine.

Vitamin K is very important for GABA and glutamate balance as well, as it is needed for healthy calcium metabolism where it reacts with glutamate and calcium to deliver calcium to the bones and teeth, and it prevents accumulation of excess calcium which would contribute to cell death. Vitamin K is a fat-soluble vitamin; however, unlike other fat-soluble vitamins, it is not stored in the body and must be consumed on a daily basis. Typically, vitamin K is produced when the friendly flora in our gut process leafy greens, but if dysbiosis is present or you're not eating leafy greens, then vitamin K is not produced in sufficient numbers and deficiency may develop.

The pancreas uses Vitamin K abundantly for sugar regulation. In addition to the brain, the pancreas is also very vulnerable to accumulation of excessive glutamate or other excitotoxins, which will further impair regulation of sugar. As we discussed previously, too much or too little insulin or glucose can both contribute to excess glutamate, therefore, keeping glutamate and GABA in balance is critical for the health of the pancreas and all its functions and the health of the pancreas is vital for maintaining the balance.

You have most likely seen the substance called phenibut for increasing GABA. I am not in favor of using it because it is an artificial means of stimulating gamma-aminobutyric acid, and remember any artificial stimulation leads to depletion. Many people report that they get addicted

to phenibut, thus demonstrating that it is indeed too stimulating which will perpetuate depletion. As I see it, phenibut is an addictive mind-altering drug.

Another popular choice for increasing GABA is l-theanine. L-theanine is a glutamate analog. Which means if you fall in the category of people who is having problems converting your glutamate to GABA, this could lead to excess glutamate rather than GABA. Additionally, l-theanine is derived from tea or mushrooms, it is an artificial means of supplementing glutamate, not natural. Furthermore, it could have traces of caffeine or fungi since from its original source, which could be problematic as well. Therefore, l-theanine may work for some but have the opposite effect for others. I prefer to avoid it unless I am working with someone who is detoxing from drugs and alcohol, in which case the need may outweigh the risks, but glutamine or lithium would be better choices.

Many manufacturers of nutritional supplements and health care practitioners have no knowledge or are not fully educated on the topic of glutamate. Therefore, it is very common for nutritional supplements, even some of the more respected brands, to contain excitotoxins. **If you tend to lean towards excess glutamate, you must be very careful with your nutritional supplements.**

It's also important to take note that it is not possible to eliminate every single source of glutamate or other excitotoxins, nor do you want to. Remember that glutamate is vital for proper brain function in small concentrations; the goal is to prevent excess. Preventing overstimulation, cell death and neurological symptoms may sometimes be a matter of moderating accumulation. The more foods or substances that one consumes that are excitotoxic the more it builds up. You may get away with a little consumption, but if consumption is high then it pushes you over the edge of the cliff and symptoms present.

One of the greatest aspects of GABA is that it also opposes norepinephrine, your other primary excitatory neurotransmitter which is also important for stimulation, but it sets off the stress response system. Like glutamate, norepinephrine is also toxic to the brain when it is in excess. Excess norepinephrine can produce many of the same kinds of symptoms that excess glutamate produces and it can sometimes be hard to tell the difference between the two. Fortunately, when you focus on increasing your gamma-aminobutyric acid then you help reduce excess norepinephrine in addition to excess glutamate.

In Summary

So, to summarize the steps that should be taken to increase GABA, it is vital that one is eating the right diet, avoiding excitotoxins, managing stress, avoiding environmental toxins, addressing nutritional deficiencies and/or genetic polymorphisms, getting adequate sleep, supporting a healthy gut and possible supplementation. It's very important that you don't just start supplementing with everything you've read will be helpful, as this usually backfires and you get the exact opposite effect. The sicker you are the slower you need to go with supplementation. Only take one thing at a time and monitor your response before trying something else. Some people must start with very minute doses.

Working with neurotransmitters is a complex and difficult process that is best done with a practitioner who has expertise in this area. However, finding someone who has enough expertise to cover all the bases we have presented on this page is very difficult as well, so you serve yourself better by being very well informed before beginning the journey. Please note that although I know a great deal, I do not know everything either. I'm always in the learning process and this page is updated periodically as new knowledge comes to light.

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