Week 7: Biomedical & Nutritional Blueprint

A variety of evidence from functional imaging studies, hint at changes in cerebral connectivity and impairments of synaptic plasticity as central pathomechanisms in autism. The molecular basis of these pathologies is not well understood up to now. Neurotrophic factors (NTF) are one of the most prominent mechanisms influencing the development and maintenance of the central nervous system, playing a key role in brain development and maintenance of neurons, and are able to critically influence the formation and elimination of neuronal connections. Thus, they are promising candidates for influencing autism pathophysiology.

The human brain is by far the most complex and intricate organ in the body. The brain is made up of billions of neurons that communicate with one another through electrical impulses (via nerve fibers known as axons) or by sending neurochemical signals to one another via synapses. New connections are constantly being made, and old, no longer useful connections are being pared throughout each individual's life, which means the precise number of synaptic connections is always in a state of flux—though at any given time there may be upwards of **100 trillion** of these connections in an adult brain.

Equally important, the number of neurons in the brain is constantly changing. Though there is still some debate on the matter, it appears that **new neurons** are constantly being formed (via a process called neurogenesis) in certain parts of the brain. Meanwhile, it has been established that degrative enzymes lead to the controlled death (apoptosis) of other neurons. The proteins responsible for regulating these processes of cell birth and cell death in the brain are known as neurotrophic factors (or neurotrophins), one of which is brain-derived neurotrophic factor (BDNF).

What Is BDNF?

Neurotrophic factors are produced in the brain and the **gut**
in limited quantities from the time we are in the womb until the time we pass away. When a neuron obtains an adequate amount of these proteins during

development, it survives, while neurons that do not receive enough do not survive. As these proteins are not abundant, neurons must constantly compete for them during development and even into old age.

Researchers have discovered numerous neurotrophins, including nerve growth factor (NGF), neurotrophic factor-3 (NT-3), neurotrophic factor-4/5 (NT-4/5), as well as BDNF. BDNF is regarded as the most active neurotrophin, and it is also extremely important to **energy homeostasis** (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4697050/) and neuronal plasticity, which is crucial to learning and memory. Decreased levels of BDNF have been associated with neurodegenerative disorders such as Parkinson's disease, Alzheimer's disease, Autism, multiple sclerosis, and Huntington's disease. Reduced BDNF levels may also be associated with type-2 diabetes.

Conversely, higher levels of the protein are associated with improved cognitive functioning, mental health, and short- and long-term memory. While it is not clear at this time if increasing BDNF levels can reverse or prevent neurodegenerative conditions, normal levels of BDNF are typically associated with better cognitive performances and overall brain function in individuals with the conditions noted above.

How to Increase BDNF Levels?

Research has found that several factors, particularly obesity, may influence BDNF levels—obese individuals have lower BDNF levels while non-obese individuals have higher BDNF levels. Additionally, research indicates that other lifestyle changes (explored below) may positively impact BDNF levels.

Rigorous Exercise

Rigorous exercise has been shown to increase BDNF levels. A study (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4697050/) found that three weeks of high-intensity cycling and five weeks of aerobic exercise improved cognitive functioning and increased levels of BDNF. Yet another study (https://pubmed.ncbi.nlm.nih.gov/21282661/) found that BDNF levels increased with aerobic exercise and that this corresponded with an increase in hippocampal volume by 2 percent. (The hippocampus plays a major role in the creation and storage of memories and

tends to decrease in volume with age.) On top of helping to combat obesity and increase BDNF, thereby improving overall brain function, these studies suggest that exercise can be especially beneficial to memory.

Dietary Changes

The typical American diet is high in calories and often contains excessive saturated fats and processed sugars can negatively impact BDNF levels and overall cognitive health. Diets that are high in processed sugars and saturated fats can affect neurotrophin levels, including BDNF levels, which in turn can lead to a reduction (https://pubmed.ncbi.nlm.nih.gov/12088740/) in hippocampal volume and neuroplasticity. To avoid these detrimental effects, individuals should stay away from processed sugars and saturated fats, and switch to a diet that is based largely on leafy vegetables, fruits, and lean proteins.

Beneficial Supplements

Some supplements have been shown to increase BDNF levels. They include:

- **Curcumin**
  (found in turmeric) has been shown to increase Brain-Derived Neurotrophic Factor (BDNF), fight depression, improve cognition, focus, and protect the brain from inflammation. Curcumin, the primary bioactive compound found in Turmeric, produces its neuroprotective effects in the brain by increasing BDNF.
- **Green tea**
- **Omega-3 fatty acids**
  (found in fish, flaxseed, and fish oil)
- **Resveratrol**
  (found in grapes, dark chocolate, pistachios, blueberries). This potent antioxidant boosts BDNF, increases cerebral circulation, improves energy and memory, and potentially promotes longevity.
- ***Ashwagandha*** has been shown to help regenerate axons and dendrites, reconstruct synapses, and restore neural networks affected by neurodegenerative disease
- ***Ginseng*** used to improve *memory* and *learning* and feeling more *alert*. We know that stress can reduce BDNF levels in the brain. One study showed that ginseng extract affected memory and learning by boosting *nerve growth factor (NGF)* and *neurite* growth in the brain.

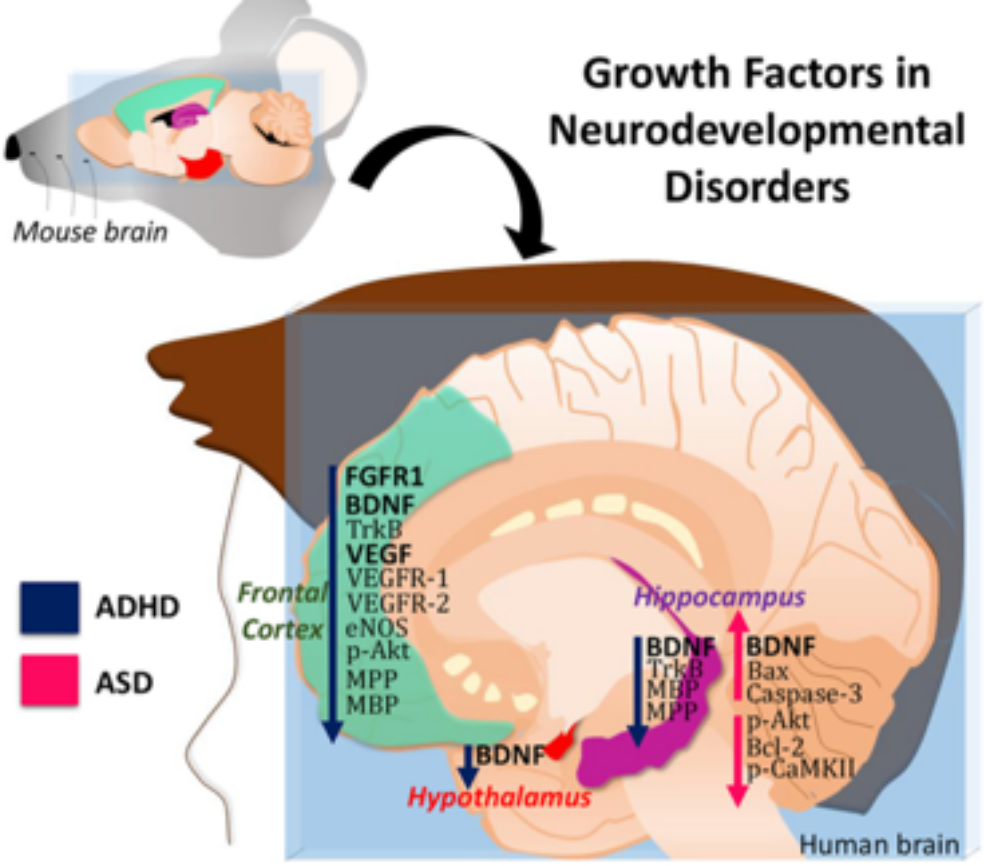
- **L-Theanine** is used as a nootropic for *anxiety, learning, mood*, and *focus*.
- **Magnesium** is critical to all of your body's electrical and electrochemical activities, involved in muscle contractions, heart rhythm, nerve function and *brain cell activity*. Research shows that ***Magnesium L-Threonate*** easily crosses the blood-brain barrier (compared to other forms of magnesium).
- **N-Acetyl L-Cysteine** (NAC) is a powerful anti-oxidant that can boost mood, lower anxiety, improve memory, and reduce compulsive behavior. There is a growing body of scientific literature exploring the use of *NAC* in the treatment of psychiatric illness. Research has shown that NAC helps boost *dopamine* release. NAC reduces inflammatory cytokines. And NAC acts in the process of glutathione synthesis.

Sunlight

While it is well known that the winter months can oftentimes affect one's mood, the precise neurobiological mechanism behind this change is not entirely known. One possible mechanism could be decreased levels of BDNF, which is correlated positively with levels of Vitamin D, a vitamin our skin makes from cholesterol when it is exposed to sunlight. In other words, more sunlight appears to lead to increases in BDNF levels. A Dutch study found significant fluctuations in serum BDNF concentrations throughout the year. Notably higher concentrations were found in the spring-summer months and lower concentrations were found in the autumn-winter months. The study suggests that Vitamin D could play a role in the regulation of this protein.

Be Social

Social engagement appears to also affect BDNF levels, particularly in developing brains that a stimulating and welcoming social environment early in life produces positive behavioral results later in life.



Expression levels of GF in blood

ADHD	ASD
↓ BDNF	BDNF ↑
↑ GDNF	TGF-β1 ↓
↑ NGF	EGF ↓
↑ NT3	NT4 ↓
↑ IGF2	HGF ↓

Research discovered that mice raised in a communal nest had significantly increased neurotrophin levels in several brain areas, particularly the hippocampus and hypothalamus, even later in life. It seems reasonable to assume that a similar phenomenon would be observable in humans, though it is unclear if adults can experience similar benefits from being in a stimulating social environment.

Children with autism show low expression levels of Neurotrophin-4 (NTF4) in blood, which have been correlated to impairments in neuroplasticity. TGF-β1 plasma levels are also reduced in autism and have a significant correlation with the low scores obtained in adaptive behaviors, stereotypy, irritability, and low social interaction. Similar findings have been reported in juvenile mice in which the treatment with TGF-β1 impairs social interaction and promotes repetitive and stereotyped behaviors. Intriguingly, TGF-β1 overexpression has the opposite effects in adult stages. Remember inflammation is usually involved.

Neurodevelopment disorder	Growth factor	Population/animal model	Biological sample analyzed	Related symptoms	Genetic polymorphism
Attention-deficit/ hyperactivity disorder	Brain-derived neurotrophic factor (BDNF) ↓ (12–14)	Children and adolescents (14)	Blood sample	Hyperactivity (15)	BDNF (rs10835210 and rs11030101) (16, 17)
		Adult (12)	Blood sample	Impairment of spatial learning (13)	BDNF (rs6265/ Val) (18)
		Adult male spontaneous hypertensive rats (SHR) (13)	Hippocampus (13)		
		BDNF$^{Val/Val}$/93 mice (19)	Hippocampus, hypothalamus, and cortex (19)		
		Dopamine transporter knockout mice (DAT$^{-/-}$) (20)	Frontal cortex (20)		
	Glial-derived neurotrophic factor ↑ (11, 21)	Children (21)	Blood sample	Inattention, hyperactivity and impulsivity behaviors (11)	Undefined
	Nerve growth factor (NGF) ↑ (22, 23)	Children and adolescents (23)	Blood sample	Attentional, learning and memory impairments (24, 25)	NGF (rs6330) (24
		Adult male SHR (22)	Blood sample		
	Neurotrophin-3 ↑ (21)	Children (21)	Blood sample	Undefined	Undefined
	Vascular endothelial growth factor ↓ (26, 27)	Juvenile male stroke-prone spontaneously hypertensive rats (SHRSP) (26, 27)	Frontal cortex (27)	Undefined	Undefined
	Insulin-like growth factor 2 ↑ (28)	Children (28)	Blood sample	Undefined	Undefined
	FGFR1 ↓ (29)	*Fgfr1*$^{tTA/tetOFGFR1}$ mice	Dorsal telencephalon (29)	Spontaneous motor hyperactivity (29)	Undefined
Autism spectrum disorder	TGF-β1 ↓ (30)	Children (30)	Blood sample	Low adaptive behaviors, stereotypy, irritability and low social interaction (30)	Undefined
	Epidermal growth factor ↓ (31, 32)	Adult (31)	Blood sample	Hyperactivity, deficit in gross motor skills, tendency for tip toeing (32)	Undefined
		Children (32)	Blood sample		
	BDNF ↑ (33, 34)	Valproic acid (VPA)-treated rat offspring (33)	Hippocampus (33)	Undefined	Undefined
		Children (34)	Blood sample		
	Neurotrophin-4 ↓ (35)	Children (35)	Blood sample	Undefined	Undefined
	Hepatocyte growth factor ↓ (36)	Children (36)	Blood sample	Undefined	Undefined

Arrows represent the level variation: increased expression (upward position) and reduced expression (downward position).

https://www.frontiersin.org/articles/10.3389/fpsyt.2017.00126/full

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4697050/

The recent use of Aluminium nanoparticles in vaccines are reported to cross blood-brain barrier and harm the brain cells because of molecular mimicry. Therefore, efficacy of vaccines need to be monitored including safety measures before one embarks on vaccinations.

Implement one at a time and wait 3 to 7 days before adding the next.
Please keep a journal to monitor the new foods and supplements.

Supplement Recommendations: *Always check with the primary medical doctor before starting supplements. To make it easier I also send an email from the Wellevate account which is a distributor that sells all the supplements and they are in a temperature controlled building for the supplements. This company is reputable and reliable as many supplement companies on Amazon are selling outdated products and reapplying labels.*

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Your health is worth it because YOU are worth it!

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