

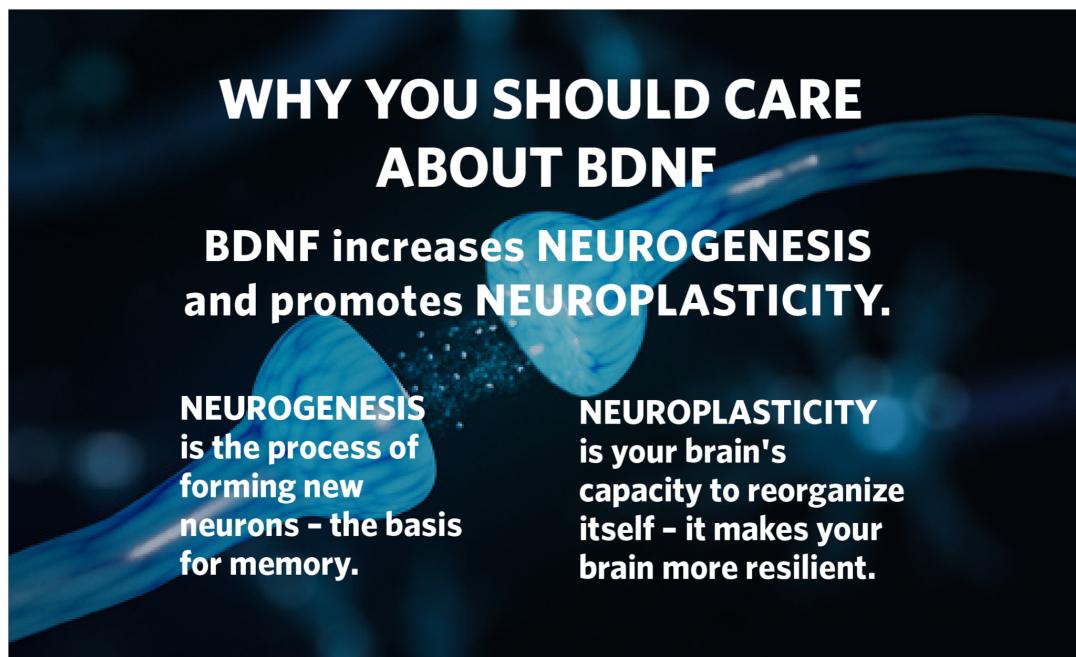
# The Cognitive Enhancement Blueprint:

## A Guide to Powerful Protocols for Reducing Brain Aging

Exercise, a potent ally in mitigating the effects of aging, plays a crucial role in protecting and preserving cognitive function. These beneficial effects are likely driven, at least in part, by the boost in **brain-derived neurotrophic factor** (BDNF) – a myokine and neurotrophic factor produced in the muscles and brain in response to vigorous exercise. BDNF is a powerful player in metabolism, aging, and various aspects of cognitive function, behavior, and memory. It stands out as a significant driving force for enhancing the brain's **neuroplasticity** and promoting **neurogenesis**.

Neurogenesis is the creation of new neurons. It is crucial in embryonic development but necessary in specific brain areas throughout the lifecycle because it's the foundation of memory.

Neuroplasticity is the brain's ability to adapt and reorganize itself in response to environmental stimuli. It facilitates learning new skills and altering synaptic connections based on new experiences, increasing the brain's resilience.



As you might expect, the primary source of BDNF is the brain, where it concentrates in the learning and memory centers, but many other tissues produce it, including the heart, lungs, gut, and a few more. Unfortunately, **BDNF production decreases as we age**, with important implications for brain health. The upshot: fewer neurons (and the connections between them), making learning and memory formation harder.

## Included in this guide:

Proven strategies to amplify BDNF expression

For example, for exercise, we provide a breakdown of specific durations, intensities, and types proven to stimulate BDNF – a compelling indicator *highly suggestive of biological contributions to neuroprotection.*

Various lifestyle interventions & protocols

We describe protocols with a high potential to enhance cognitive function or slow brain aging. We explore those tied to BDNF and those that work via independent mechanisms.

## How to use this guide:

Each of the guide's sections delves into the cognitive enhancements and BDNF-promoting aspects of various lifestyle behaviors, such as exercise and diet. Accompanying these insights is a segment outlining some of "Rhonda's Protocols."

These protocols reflect a blend of my personal practices and evidence-based recommendations that intrigue me for future exploration. Instead of detailing a rigid daily regimen, they represent an evolving toolkit of strategies I value for their robust scientific support, minimal risks, and promising potential to uplift cognitive well-being.

## Lifestyle behaviors can counter some of the effects of brain aging.

Certain lifestyle behaviors mitigate the effects of brain aging, fostering cognitive vitality and resilience. A common feature of these behaviors is their capacity to drive beneficial increases not only in brain BDNF but in plasma BDNF, too. This dual outcome extends BDNF's influence beyond the brain and indicates that [plasma BDNF likely can cross the blood-brain barrier](#), potentiating its effects. Here are some behaviors that promote BDNF.

### Exercise

The benefits of exercise on mental and cognitive health are [well established](#). Many of these benefits likely relate directly to exercise's capacity to increase BDNF levels. But not all exercise is created equal. Exercise intensity matters and is critical for stimulating increased BDNF expression.

Intense exercise promotes the production of lactate, a metabolic byproduct of glucose metabolism. The body "shuttles" lactate from the muscles to various tissues like the heart and brain, serving as an energy source. Once in the brain, lactate acts as a signaling molecule to activate BDNF.

Lactate is crucial in elevating BDNF levels, with [high-intensity interval training \(HIIT\) notably boosting BDNF](#) more than moderate continuous exercise.

- **Optimal duration for BDNF boost:** Long duration (about 40 minutes) moderate- to vigorous-intensity exercise (at least 65 percent max heart rate) elicited the greatest effects on BDNF levels – nearly [one-third higher than before exercising](#) – in young, healthy men. However, a 30-minute session is [relatively common in most studies](#) and appears sufficient to [induce sustained \(24-hour\) improvements in memory](#).
- **Short-term spike, long-term effects:** The rise in BDNF levels following exercise is short-lived, [usually less than an hour post-exercise](#). However, the long-term impact is considerable, with animal studies demonstrating that exercise leads to [increased neurogenesis in the brain](#).
- **High-intensity cycling outperforms prolonged cycling for BDNF increases:** Six minutes of high-intensity cycling intervals (six 40-second intervals at 100 percent of VO<sub>2</sub> peak) [increased every metric of circulating BDNF](#) by four to five times more than prolonged, low-intensity cycling (90 minutes at 25 percent VO<sub>2</sub> peak). The four- to fivefold increase in plasma-derived BDNF correlated with a sixfold increase in plasma lactate.
- **Enhanced plasma BDNF and brain volume in older adults:** After participating in a six-month dance program, older adults' [brain volumes increased in areas crucial for memory](#), and plasma BDNF levels rose significantly.

Mechanistically, BDNF plays a crucial role in cognitive improvements, [as demonstrated in animal studies](#), where blocking BDNF's action reverses the cognitive benefits of exercise, underscoring the vital link between physical activity and brain health.

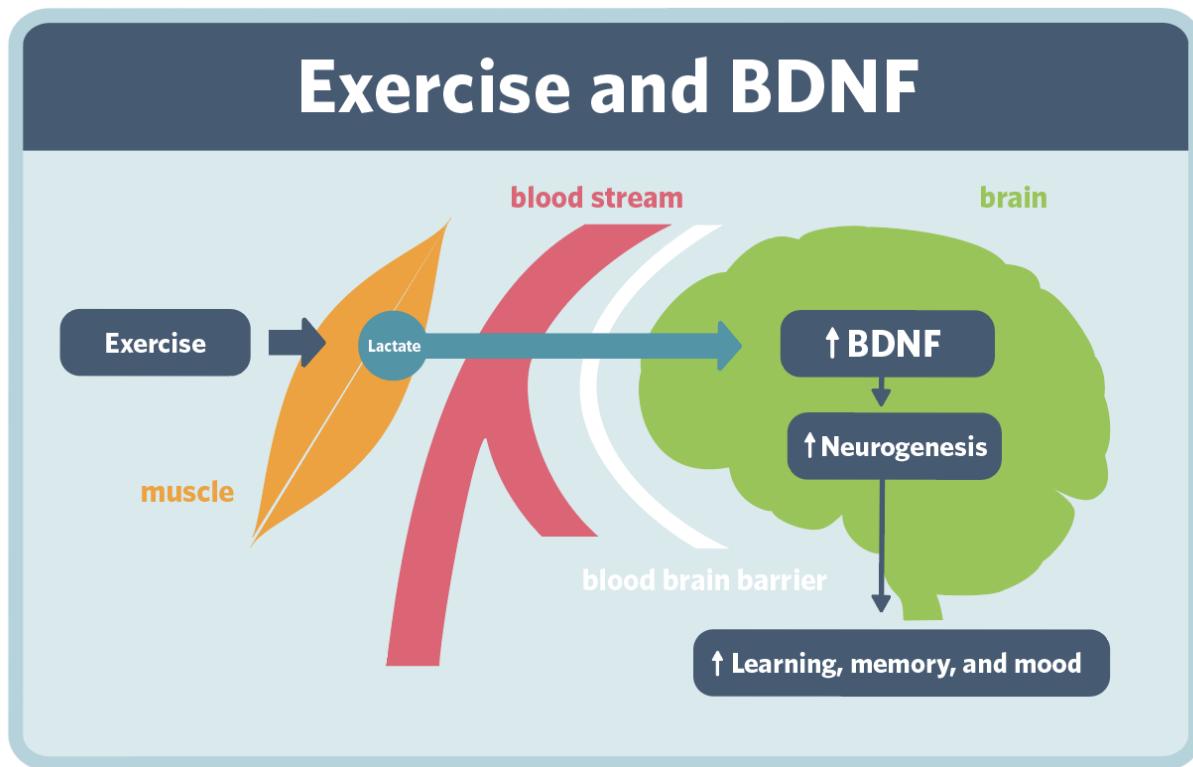
To sum up, exercise significantly boosts BDNF – essential for cognitive health – through various means. Extended moderate- to vigorous-intensity exercise sessions notably increase BDNF levels, with the benefits persisting well beyond the exercise period. High-intensity cycling, in particular, demonstrates a remarkable ability to boost BDNF levels, tied closely to increased lactate production. The effects of exercise-induced increases in BDNF are not limited to young people: Older adults also experience enhanced brain volume and BDNF levels with regular physical activity.

### Rhonda's recommendations and personal practices

- **Outdoor running:** Engage in a 30-minute run outdoors, aiming for approximately 80 to 85 percent of your max heart rate. Repeat this two to three times weekly for optimal results.
- **High-intensity interval cycling:** Start with a warm-up, followed by seven 45-second cycling intervals at 90 to 95 percent of your max heart rate, with brief 15-second recovery periods. Conclude with a cool-down. Perform this routine two to three times weekly.
- **Double Tabata cycling sessions:** Execute two consecutive Tabata sets, each involving 20-second intervals at 90 to 95 percent of your max heart rate, interspersed with

10-second recovery periods. Complete this 16 times with an extended break between each Tabata set. Aim for one to two sessions weekly.

- **Norwegian 4x4 HIIT protocol:** Perform four minutes of intense exercise at the highest heart rate you can maintain, followed by three minutes of recovery. Repeat this cycle four times. Incorporate this protocol into your routine once a week.



### How exercise drives BDNF production.

Exercise promotes the release of lactate, a myokine produced in skeletal muscle. Lactate enters the bloodstream and then crosses the blood-brain barrier, promoting BDNF production.

### Hot baths and sauna use

Engaging in heat therapy through soaking in a hot tub or enjoying a sauna session may also elevate your BDNF levels, enhancing brain health. This effect aligns with the known benefits of heat therapy in [reducing the risk of neurodegenerative diseases](#), such as dementia and Alzheimer's.

- **Hot baths boost BDNF:** A 20-minute hot water soak at 42°C (108°F) increased BDNF in healthy young men to levels that [were two-thirds higher](#) than before soaking. Levels remained elevated for 15 minutes afterward.

- **Sauna use increases BDNF:** A ten-week regimen of regular heat exposure in a sauna at 80°C (176°F) [increased BDNF levels more effectively](#) than light-intensity exercise, positioning sauna bathing as a promising method for promoting brain health through BDNF production.

#### Rhonda's recommendations and personal practices:

- **Dry sauna protocol:** Spend 20 to 30 minutes in a dry sauna at temperatures ranging from 79.4°C to 82.2°C (175°F to 180°F) with about 10-20 percent humidity. Aim for three to four sessions weekly for optimal results.
- **Saltwater jacuzzi regimen:** Enjoy 30 minutes in a saltwater jacuzzi at 40°C (104°F). Incorporate into your routine three to four times weekly.

## BDNF: Brain-Derived Neurotrophic Factor



### Omega-3 fatty acids

Omega-3 fatty acids are indispensable for the development and function of the central nervous system across all stages of life. They play a crucial role in maintaining the integrity of cell membranes and offer antioxidant and anti-inflammatory benefits.

Three omega-3 fatty acids are essential to human health: alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). ALA is in plant oils, such as those from walnuts and flaxseeds. EPA and DHA are in the flesh and fats of fish and marine animals. The EPA and DHA from marine sources are particularly potent in enhancing brain-derived neurotrophic factor, a key player in brain health and cognitive function.

- **Omega-3 increases BDNF:** Multiple studies point to the [BDNF-boosting effect of omega-3s in humans](#), particularly at doses greater than 2 grams daily.

- **Long-term omega-3 boosts BDNF:** Long-term supplementation (greater than 10 weeks) and moderate doses (about 1.5 grams daily) have more robust effects on BDNF levels, [especially in people under the age of 50](#).
- **Omega-3 and trauma recovery:** When trauma patients received omega-3 fatty acid-rich fish oil supplements, their proBDNF (a BDNF precursor) levels [were nearly five times higher](#) than those who received a placebo. Trauma patients with higher proBDNF levels were also [less likely to have depression](#) – a common occurrence after trauma.

#### Rhonda's personal practices:

- Approximately 2 grams of triglyceride-form EPA in the morning and 2 grams of triglyceride-form DHA in the evening.

#### Polyphenols

Polyphenols are a large family of naturally occurring organic compounds characterized by multiple phenol units. Flavonoids – a type of polyphenol widely found in fruits, vegetables, tea, wine, and cocoa – are known for their diverse beneficial health effects, including antioxidant and anti-inflammatory properties, including in the brain.

- **High dietary flavonoid intake improves BDNF:** Increasing fruit and vegetable intake to include high flavonoid content (>15 milligrams per 100 grams) [increased serum BDNF levels](#), which correlated with improved global cognition.
- **Flavonoid-rich cocoa boosts BDNF and cognition:** Older adults consuming a high-flavanol cocoa drink (494 milligrams of flavanols) for 12 weeks [increased serum BDNF levels](#), correlating with cognitive performance improvements.

#### Rhonda's recommendations and personal practices:

- **Morning smoothie recipe:** one cup of organic frozen blueberries, blackberries, strawberries, raspberries, some kale leaves, and avocado.
- **Daily afternoon cocoa flavanol drink:** one scoop of CocoaVia cocoa mix with 500 milligrams of flavanols mixed with hot water and stevia.

#### Zinc

Zinc is the most abundant trace element in the brain, affecting BDNF expression and activity by switching on the activity of proteins involved in [converting the biologically inactive form of BDNF \(pro-BDNF\) to mature BDNF](#). The RDA for adult males is 11 milligrams per day and 8 milligrams per day for adult females. Approximately 12 percent of adults in the United States don't get enough zinc in their diet, and as many as 20 percent of older adults don't get enough.

- In a meta-analysis of multiple studies where participants received 30 milligrams of supplemental zinc daily for three months, [zinc supplementation enhanced circulating levels of BDNF](#) better than a placebo.

## Meditation

Meditation, a practice rooted in ancient tradition, has been validated by modern science for enhancing cognitive functions. Human studies consistently show that regular meditation can improve executive function and memory. This cognitive sharpening is primarily due to increased brain-derived neurotrophic factor (BDNF), a key molecule in brain plasticity, learning, and memory.

Experienced meditators who participated in a three-month-long yoga and meditation retreat had [threefold increases in their plasma BDNF levels](#) compared to their pre-retreat levels. The meditators' self-reported scores for depression and anxiety (which were already low) [decreased by about 60 percent](#).

## Mental training

It's well-known that physical exercise boosts BDNF levels, but mental exercise is equally potent. Engaging the brain with new and novel experiences fosters neuroplasticity – its remarkable capacity for growth, adaptation, and change.

- When sedentary, older women with mild cognitive impairment engaged in eight weeks of computer-based mental training, their working memory increased by 22 percent, and their processing speed improved by 10 percent – gains that [lasted at least six months after the intervention](#). Plasma BDNF levels increased by 26 percent in women who engaged in mental training but dropped by 13 percent in women who didn't.

## Probiotics

An abundance of evidence points to a strong connection between BDNF levels and the gut microbiome, the collection of microorganisms that live in the human digestive tract. Probiotics may support a healthy microbiome, bolstering cognitive function.

- When people diagnosed with mild cognitive impairment took 800 milligrams of a *Lactobacillus plantarum* probiotic supplement for 12 weeks, they experienced rapid [improvements in attention, working memory, and verbal memory](#). The greatest improvements in cognitive function in people who took the probiotic occurred in those with greater increases in serum BDNF levels.
- Several clinical trials have found that [probiotics increased BDNF levels in people with neurological disorders or depression](#), especially when the probiotics were enriched with *Lactobacillus* and *Bifidobacterium*, two microbes associated with gut health.

## Dietary patterns

The typical Western diet, rich in simple carbohydrates and saturated fats, reduces BDNF levels. However, healthy dietary patterns increase BDNF.

- A low-carb diet plus HIIT:** When adults with metabolic syndrome followed a low-carb diet for four weeks (about 40 percent fewer calories than usual), their [BDNF levels increased by 20 percent](#).

- Higher BDNF levels translated to better cognitive performance, with study participants taking about 14 percent less time to complete a dynamic test of cognitive speed and flexibility.
- Adding HIIT to the dietary regimen increased BDNF levels by 38 percent – even when measured 72 hours after the workout.
- **Moderate caloric intake:** When healthy overweight or obese men and women followed a three-month reduced calorie diet requiring a 25 percent reduction in caloric intake, their [BDNF levels increased by 50 percent](#).

There's more to BDNF than its role in the brain.

The presence of BDNF in capillary beds and throughout the body's systemic circulation hints at the molecule's capacity to perform in various contexts. For example, **BDNF is a biomarker for some disease states.**

- **Suicide risk:** BDNF levels are typically lower among [women who have attempted suicide](#) than women who have not.
- **Parkinson's disease:** Low BDNF levels are often seen in [early-stage Parkinson's disease](#) and may serve to distinguish between Parkinson's disease and essential tremor.
  - High BDNF levels may manifest in [later stages of Parkinson's disease](#) – possibly the body's attempt to compensate for more severe symptoms.
- **Trauma and depression link:** Short-term increases in BDNF levels that occur with physical or other trauma often correlate with better outcomes for the [risk of developing depression](#).
- **Gut permeability:** BDNF [regulates the expression of tight junction proteins](#) – essential for maintaining gut barrier integrity.
- **Stroke:** BDNF levels are markedly lower immediately after a stroke and may [predict stroke recovery outcomes](#).

## Conclusion

**Lifestyle is a powerful tool for mitigating the effects of aging on cognitive function**, with exercise – particularly the vigorous kind – taking the lead. Exercise promotes muscles' production of lactate, a metabolic byproduct that increases the production of BDNF, a crucial player in brain health. Other lifestyle factors, such as hot baths, sauna use, and meditation, and dietary components, such as omega-3 fatty acids, zinc, and dietary fiber, also contribute to BDNF production. However, the effects of BDNF extend beyond the brain, serving as a biomarker for various diseases and supporting gut health.

An abundance of evidence points to the multifaceted role of BDNF and underscores the importance of adopting behaviors that promote its increase for overall cognitive well-being.

[Learn more about BDNF in our comprehensive overview article](#)