Creatine: Helpful or Hype?

Can Creatine Supplementation Boost Your Brain?

Have you heard about creatine, a compound your body uses for maintaining cellular energy? Cells in your liver and brain produce creatine. You can also obtain it from your diet or a supplement.

Athletes have been using creatine supplements for decades to enhance muscle mass, performance, and recovery.

A growing number of studies are investigating whether creatine supplementation may help combat a range of brain health issues, such as sleep loss, cognitive fatigue, traumatic brain injury, and even neurodegenerative conditions like Alzheimer's disease (AD).

This article provides an overview of creatine, where it comes from, and a summary of the proven benefits of creatine supplementation for muscle health and emerging evidence on brain health benefits. It also provides some critical caveats to consider before you decide to take a creatine supplement.

WHAT IS CREATINE?

Creatine is a compound produced in your liver and brain from reactions involving the amino acids arginine, glycine, and methionine.

Your liver and brain produce about half of the creatine found in your body. The other half comes from your diet, from foods like red meat, seafood, and poultry.

Almost all of your creatine stores, 95%, reside in your skeletal muscles, and less than 5% are found in your brain. The brain makes creatine and can also bring in creatine produced by the liver or from dietary sources across the blood-brain barrier.

Creatine is essential for high-energy demands during muscle and brain development. Children born with rare genetic errors in making or transporting creatine may develop muscle weakness, gastrointestinal problems, intellectual disabilities, speech delay, and autism-like behaviours.

Depending on the specific genetic defect, oral supplementation with creatine monohydrate can effectively address symptoms if initiated early enough, according to the National Organization for Rare Disorders.

CREATINE HELPS MAINTAIN CELLULAR ENERGY, ESPECIALLY DURING INTENSE PHYSICAL OR MENTAL ACTIVITY.

"Your body uses creatine to regenerate adenosine triphosphate, or ATP, the energy currency used by all cells," said Dr. Austin Perlmutter, a Seattle-based board-certified internal medicine physician, clinical researcher, and *New York Times* bestselling author.

SUPPLEMENTATION FOR MUSCLE HEALTH

Athletes in the Soviet Union and Eastern Bloc countries began using creatine supplements in the 1970s. Elite and recreational athletes worldwide take creatine supplements to enhance muscular strength and recovery.

According to the International Society of Sports Nutrition, creatine monohydrate is a safe, effective, and well-studied supplement for boosting athletic performance, enhancing post-exercise recovery, and helping athletes tolerate heavy training regimens. The U.S. Food and Drug Administration categorizes creatine monohydrate supplements as "generally recognized as safe."

According to the Harvard Medical School, creatine monohydrate supplementation helps muscles rapidly produce energy and may enhance power or bursts of speed during activities such as sprinting and weightlifting. It may also hasten muscle recovery after strenuous activities by providing additional energy for healing.

CREATINE AND SEX-RELATED DIFFERENCES

- **Women can have 70% to 80% less total body creatine stores than men.**
- **Women's brains have lower creatine levels than men, especially in the frontal lobe areas responsible for mood, cognition, memory, and emotion.**
- **Women typically consume significantly less dietary creatine than men.**

It may also help offset the age-related loss of muscle mass, strength, and functional ability, called sarcopenia, along with regular resistance training and a well-balanced diet.

Dr. Darren Candow is Director of the Aging Muscle and Bone Health Laboratory and Director of Research for the Athlete Health and Performance Initiative at the University of Regina in Saskatchewan. His research focuses on developing effective lifestyle interventions that involve creatine supplementation and resistance training for improving muscle, bone, and brain health. He has published numerous review papers summarizing the latest evidence on creatine supplementation.

In a review of the effects of supplementation on women's health across their lifespan, considerable evidence showed that it increases women's strength, power, and athletic performance without a significant change in body weight.

By contrast, men taking creatine monohydrate may rapidly and temporarily gain weight, especially if they use a loading dose strategy or consume it with a recommended 1 g of carbohydrate for every kilogram of body weight.

This research also revealed that creatine monohydrate supplementation may be important for women during life stages that feature increased demand for cellular energy, including during menses, pregnancy, menopause, and after menopause. His paper was published in the journal *Nutrients* in March 2021.

Strong muscles are essential for good brain function. According to Dr. Perlmutter,

"HEALTHY MUSCLES APPEAR TO PROMOTE A HEALTHIER BRAIN IN PART THROUGH THE PRODUCTION OF SIGNALLING MOLECULES CALLED MYOKINES.

Proteins that transmit messages from muscles to other tissues, including the brain, are called myokines. When your muscles contract or grow new cells, myokines released into your bloodstream reach your brain, where they help regulate cognition, mood, and emotions.

Myokines can also help the brain form new neurons and increase the strength of synaptic connections, which in turn improve learning and memory.

SUPPLEMENTATION FOR BRAIN HEALTH?

Processing and transmitting information through electrical signals, the brain's primary activities, requires significant energy. In fact, despite making up only 2% of total body weight, the brain of an average resting adult consumes about 20% of the body's total energy.

Since creatine plays a critical role in maintaining cellular energy during demanding brain activities, researchers have been investigating the potential of creatine monohydrate supplementation in providing brain health benefits.

"Overall, the evidence on whether creatine monohydrate supplementation is beneficial for supporting brain health is in its infancy," said Dr. Candow.

"Average, healthy individuals make enough brain creatine. When brain creatine stores are low, supplementation can increase the levels and may moderately improve cognition and memory in conditions that stress the brain, like sleep deprivation and traumatic brain injury.

Here are some highlights of findings from small studies that explored the effects of creatine supplementation in a range of brain health conditions in humans:

Hypoxia. Brain cells use oxygen to convert ATP into energy. A lack of sufficient oxygen, called hypoxia, is associated with the development of age-related neurodegenerative diseases like AD.

A small study by researchers at the University of Auckland in New Zealand, was the first to demonstrate that creatine monohydrate supplementation could restore cognitive focus after oxygen deprivation.

Normal air contains about 21% oxygen, but in this study, 15 healthy adults, all age 55 or younger, breathed air with only 10% oxygen for 90 minutes after taking a 20 g daily dose of creatine for a week. The paper was published in the *Journal of Neuroscience* in 2015.

Sleep deprivation. A recent small study conducted in Germany found that a high, single dose of creatine monohydrate partly reversed deterioration in cognitive performance due to sleep deprivation compared to a placebo.

A total of 15 healthy adults in their early 20s participated in the study (8 women and 7 men). The creatine dose was 0.35 g per kg of body weight, so a person weighing 70 kg, for example, took 24 g.

The maximum cognitive effect was reached four hours after participants took the creatine monohydrate, and the effect lasted about nine hours. The paper was published in February 2024 in *Scientific Reports*.

> ***"Creatine monohydrate supplementation may help reverse brain fog in a sleep-deprived brain."***

"However, the average young adult getting adequate sleep and nutrition will not notice any magical ability to retain more information when studying for exams, for example," Dr. Candow advised.

Traumatic brain injury (TBI). Altered blood flow in the brain after a TBI leads to an imbalance in the supply and demand for energy in brain cells and reduces brain stores of creatine.

A clinical trial among 39 children and adolescents demonstrated that creatine monohydrate supplementation had promising potential for improving outcomes after TBI.

Taking 0.4 g of creatine per kilogram of body weight daily for six months reduced post-traumatic amnesia, intubation time, and length of stay in intensive care and also improved headaches, dizziness, and cognitive function compared to a placebo. The study was published in 2006 in *The Journal of Trauma and Acute Care Surgery*.

Depression and mood disorders. In a review paper published in *Sports Medicine* in June 2023, Dr. Candow and co-authors noted that lower creatine stores in the prefrontal cortex may be associated with a greater likelihood of

WHAT IS THE OPTIMAL CREATINE SUPPLEMENT DOSE?

"Creatine monohydrate, typically sold in a powdered format, is the most common and most studied creatine supplement. It is similar to what's made naturally in the body and has an exceptional safety profile," said Dr. Candow.

He published a review of the optimal dose of creatine monohydrate associated with various health benefits in *Advanced Exercise and Health Science* in May 2024. Highlights of his findings were as follows:

01 **Skeletal muscle benefits:** A loading phase of 20 g daily for up to a week, with or without a subsequent maintenance phase of 3 g to 5 g daily, appears sufficient to produce muscle benefits. Alternatively, a daily dosing strategy of 0.10 g to 0.14 g of creatine per kg of body weight is a viable option, especially for healthy older adults.

02 **Bone benefits:** A few studies have shown that 0.10 g to 0.14 g of creatine per kilogram of body weight can favourably affect bone biology and structure in healthy older adults participating in exercise training. "The lowest dose that has ever shown bone benefits is 8 g daily," said Dr. Candow.

03 **Brain health benefits:** The optimal dose and the duration needed to enhance brain function are unclear. Increasing brain creatine stores likely requires a dose of 20 g daily or higher or 0.3 g per kg of body weight for at least a week, or 4 g or more daily for several months.

Dr. Candow told Mind Over Matter® that he takes a 10 g dose of creatine monohydrate daily. "A total of 3 g to 5 g daily as a dietary supplement for muscle health is fine, but older adults, especially those looking for bone and brain benefits, may wish to increase their daily dose to 8 g," he said. "Given my body weight, 10 g per day is appropriate. I divide it up into several smaller doses during the day."

Note: Always consult your healthcare provider before taking any supplement to ensure it is right for you.

experiencing depression and anxiety, and that creatine monohydrate supplementation may help alleviate symptoms.

For example, taking at least 20 g of creatine monohydrate daily for 4 weeks or 5 g daily for at least 8 weeks may help ease the symptoms of major depressive disorder.

Memory. Taking creatine monohydrate moderately improved memory in healthy adults compared to a placebo, especially for older people aged 66 to 76, according to a meta-analysis and systematic review by Dr. Candow published in *Nutrition Reviews* in 2022.

"Keep in mind that this finding was based on a small number of clinical trials containing small numbers of participants," said Dr. Candow.

> **WE NEED BIGGER CLINICAL TRIALS WITH HUNDREDS OF PEOPLE TO DETERMINE IF TAKING CREATINE MONOHYDRATE REALLY CAN IMPROVE MEMORY.**

Slowing neurodegenerative disease progression. While there is some evidence that creatine supplementation improves outcomes for people with muscular dystrophy, Dr. Candow's review of the literature found scant evidence suggesting it can slow the progression of neurodegenerative diseases such as Parkinson's, amyotrophic lateral sclerosis, or AD.

> ***Creatine supplementation may help improve brain energy in conditions like dementia or Alzheimer's disease where the brain is begging for help, similar to results we are starting to see with clinical depression. But the evidence is not there yet.***

Dr. Candow continued, "I am planning a clinical trial of creatine supplementation in people with Alzheimer's and dementia, in collaboration with colleagues at the University of Northern Iowa in late 2025."

CREATINE CAVEATS

If you are considering taking a creatine supplement, keep the following caveats in mind:

Determining sufficiency or deficiency is impossible for most people. "Without access to expensive brain imaging technology used in only a few labs worldwide, called magnetic resonance spectroscopy, it's impossible to know if brain creatine stores are sufficient or deficient and whether people may benefit from supplementation," Dr. Candow advised.

Remember the earlier statistic that women can have 70% to 80% less creatine stores than men? One supplement sold in the U.S. is using that claim to imply women are deficient.

> **REMEMBER THAT SEX-RELATED DIFFERENCES IN CREATINE STORES MAY BE JUST DIFFERENCES, NOT PROBLEMS THAT NEED FIXING, ADVISED DRS. PERLMUTTER AND CANDOW.**

So far, only creatine monohydrate has been proven safe and effective. Supplement manufacturers are now selling other types of creatine, such as creatine hydrochloride. "Some newer products purportedly reach the digestive system and bloodstream quicker than creatine monohydrate, but the truth is that creatine is useless until it gets into the tissue," said Dr. Candow.

"Many people don't realize creatine monohydrate has a proven safety profile. The safety of newer forms of creatine is unknown and no studies yet demonstrate they are superior to creatine monohydrate."

"Creatine hydrochloride may be more quickly absorbed than creatine monohydrate," said Dr. Perlmutter. "However, the mechanism of action of both types of creatine are the same: they contribute to the regeneration of ATP, our cellular energy currency."

Taking a creatine supplement may increase your creatinine lab results. After your body uses creatine, it is broken down to form creatinine, a waste product your blood exports to your kidneys, where it is excreted in urine.

While studies have shown that consuming recommended doses of a creatine supplement does not affect kidney function in healthy people, an increase in your creatinine lab results may lead your doctor to wonder if your kidney function is declining.