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REPORT

Anti-Aging Benefits of Creatine

New Research Suggests Creatine Combats Muscle Loss, Improves Brain Function, and May Modulate Inflammation

By Will Brink

Creatine is a nutrient with a long list of potential medical, exercise-enhancing, and anti-aging applications. As discussed in the March 2003 issue of Life Extension, creatine may play a role in preventing and treating diseases such as muscular dystrophy that affect the neuromuscular system.[1] *Creatine has potential therapeutic applications in aging populations and against disorders such as wasting syndromes, muscle atrophy, fatigue, Parkinson's disease, and Huntington's disease, as well as mitochondrial disorders and brain pathologies. Another article in the September 2003 issue of* Life Extension *examined creatine's potential role in increasing growth hormone levels, reducing homocysteine levels, and improving the symptoms of chronic fatigue syndrome.*[2]

In this article, we will examine exciting new research on the use of creatine by older adults to fight age-related muscle loss (sarcopenia), improve function in both healthy and damaged brains, and perhaps modulate inflammation. Creatine is proving to be one of the most promising, well-researched, and safest supplements ever discovered for an exceptionally wide range of uses.

What is creatine? In a nutshell, creatine helps the body generate energy. Adenosine triphosphate (ATP), formed in the mitochondria, is often referred to as the body's "universal energy molecule." When ATP loses a high-energy phosphate molecule to become adenosine diphosphate (ADP), it must be converted back to ATP before it can be used again to produce energy. Creatine, stored in the body as creatine phosphate, can donate a phosphate group to ADP, thus recharging it to energy-producing ATP. By promoting faster and more efficient recycling of ATP, creatine helps provide the fuel our bodies need to accomplish physical and metabolic tasks.[1]

THE SCOURGE OF AGING: SARCOPENIA

In literally dozens of studies, creatine has been shown to increase strength and muscle mass in young adults and to aid in rehabilitative strength training.[3-13] Until recently, data concerning creatine's effects on older adults was very limited. One of the greatest threats faced by aging adults is the steady loss of lean body mass (muscle) needed to maintain a healthy, functional lifestyle. The medical term for this loss of muscle tissue is sarcopenia, a condition that is only now getting the recognition it deserves by the medical and scientific community.

Sarcopenia can be defined as the age-related loss of muscle mass, strength, and function. For decades, the medical community has focused on the loss of bone mass (osteoporosis) in aging adults, but has paid little attention to the loss of muscle mass that occurs with aging. This loss of muscle mass can affect a person's ability to be functional, perhaps even more so than a loss of bone mass. As with most medical conditions, it is easier, less expensive, and more effective to prevent or slow the progression of this condition than it is to treat it later in life. Sarcopenia generally appears in adults after the age of 40 and accelerates after the age of approximately 75.

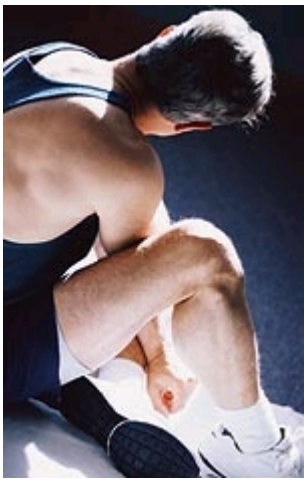
Although sarcopenia is mostly seen in physically inactive adults, it is not uncommon in people who remain physically active throughout their lives. Thus, while remaining physically active is essential to avoiding sarcopenia, physical inactivity is not the only contributing factor to its development. Like osteoporosis, sarcopenia is a multifactorial process whose contributing factors may include decreased hormone levels (particularly of growth hormone, insulin-like growth factor 1, and testosterone), lack of adequate protein and calories in the diet, oxidative stress, inflammatory processes, and loss of motor nerve cells.[14-33]

HOW CREATINE AFFECTS OLDER ADULTS

With aging and inactivity, muscle wasting or atrophy most often occurs in fast-twitch muscle fiber. These fibers, which are recruited during high-intensity, low-endurance movements such as weight lifting and sprinting, are the most profoundly affected by creatine.

In a study examining creatine's effect on isometric strength and body composition, 28 healthy men and women over the age of 65 received either five grams of creatine daily or a placebo.[34] In this random, double-blind study, both the creatine and placebo groups were put on a resistance (weight) training regimen. Fourteen weeks of training resulted in significant increases in all measurements of strength, functional tasks, and muscle fiber area in both groups. However, the creatine group experienced significantly greater increases in fat-free muscle mass, isometric knee extension strength, isometric dorsiflexion (ankle) strength, and intramuscular creatine levels. The researchers concluded, "the addition of creatine supplementation to the exercise stimulus enhanced the increase in total and fat-free mass and gains in several indices of isometric muscle strength."[34]

An abundance of recent studies has found creatine to have beneficial effects in older adults, especially when combined with a resistance training protocol. One study examined the effects of creatine supplementation on muscular performance in older men over a brief time period.[35] The study authors concluded, ". . . seven days of creatine supplementation is effective at increasing several indices of muscle performance, including functional tests in older men without adverse side effects. Creatine supplementation may be a useful therapeutic strategy for older adults to attenuate loss in muscle strength and performance of functional living tasks."



One especially noteworthy study found that creatine's positive effects on strength and lean tissue in older adults continued for at least 12 weeks after they stopped using it.[36] According to the study authors, "withdrawal from creatine had no effect on the rate of strength, endurance, and loss of lean tissue mass with 12 weeks of reduced-volume training." For most creatine users, however, optimal benefits occur with continuous use of creatine, which is both safe and well tolerated.

THE SECRET TO AGING: CELLULAR ENERGY

What is one important difference between an older and a younger adult? The answer is cellular energy: each cell's ability to produce energy, detoxify harmful compounds, and defend itself against free radical damage and other assaults. An increase in oxidative stress, coupled with a cell's inability to produce essential energy molecules such as ATP, is a hallmark of aging and is present in many disease states.[37-40] While a younger person's cells can efficiently meet these challenges, an older person's cells are poorly equipped to do so. Over time, damage accumulates in older cells, and cell death can occur. In younger healthy adults, healthy new cells rapidly repair or replace older cells, but this process slows with age.

A decline in muscle mass with aging, or sarcopenia, may be related to a decline in mitochondrial function. Without optimal functioning of these energy generators that are found in every human cell, both the cell and the entire body experience a decline in function. Research has established that older adults tend to have lower tissue levels of creatine phosphate, ATP, and other essential high-energy molecules. Older adults are also less adept at replenishing these essential molecules after exercise.

One study examined skeletal muscle mitochondrial function and lean body mass in healthy, exercising elderly adults.[41] The study measured mitochondrial function and recovery time in 45 older adults (with an average age of 73) and 20 younger subjects (average age of 25) who were matched for body mass. The investigators then had the two groups exercise at different intensity levels. As other studies have found, the older adults had lower baseline creatine phosphate and ATP levels than did their younger counterparts, and they were slower to replenish tissue levels after exercise. As the researchers reported, "Our data suggest that mitochondrial function declines with age in healthy, exercising elderly adults and that the decline appears to be influenced by the level of physical activity." Thus, the older subjects not only had lower levels of essential high-energy compounds to begin with, but those levels were further diminished with more intense exercise.

As studies in older adults show, creatine in supplemental form can ameliorate some of the physiological decline that occurs with aging. Creatine may be one of the safest, most effective non-prescription compounds currently available to improve cellular energy.

CREATINE'S ANTI-INFLAMMATORY EFFECTS

Creatine may also help to modulate inflammation, at least after exercise. One study examined creatine's effect on inflammation and muscle soreness in experienced runners after a 30-kilometer race.[42] The researchers looked at inflammatory and muscle soreness markers—creatine kinase, lactate dehydrogenase, prostaglandin E2, and tumor necrosis factor-alpha—in runners before and after the race. One group of runners supplemented for five days before the race with 20 grams of creatine and 15 grams of maltodextrine daily, while the control group received only the maltodextrine. Blood samples were collected before the race, immediately afterwards, and 24 hours after the race.

As one would expect, the control group had large increases in all four markers: a fourfold increase in creatine kinase concentration, a 43% increase in lactate dehydrogenase, more than a sixfold increase in prostaglandin E2, and a doubling of tumor necrosis factor-alpha. All these markers indicate a high level of cell injury and inflammation in these athletes. In the creatine group, however, supplementation attenuated the exercise-induced changes observed for creatine kinase by 19%, for prostaglandin E2 by 61%, and for tumor necrosis factor-alpha by 34%, while entirely negating the increase in lactate dehydrogenase plasma concentration observed in the control group. Participants supplementing with creatine reported no side effects. The researchers concluded, "These results indicate that creatine supplementation reduced cell damage and inflammation after an exhaustive, intense race."

These findings underscore an important point. Regular exercise is an essential component of wellness for people who want to improve their health, minimize body fat, and retain essential muscle mass. Exercise, however, also has potentially negative effects that the body must manage, including increased free radical production. Creatine thus may be beneficial in helping to modulate the inflammatory stress generated by exercise.

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CREATINE IMPROVES BRAIN FUNCTION

Perhaps the most compelling case for creatine supplementation is its ability to modulate brain function and metabolism. Previous articles in Life Extension have examined some of creatine's applications in promoting muscle, brain, and heart health.[1,2] Ongoing research indicates that creatine is an important nutrient for brain function and metabolism in both healthy people and those who suffer from brain damage or brain-related disease. Traumatic brain injuries affect thousands each year. Adding to this tragedy is that much of the damage is caused not by the immediate injury to the brain, but by cell death caused by ischemia (lack of blood flow and oxygen to tissues), free radical damage, and oxidative stress.

A cell's ability to function is directly related to its mitochondrial health and ATP status. Even small changes in ATP supply can have profound effects on the tissues' ability to function properly. Heart tissue, brain neurons, and other highly active tissues are very sensitive to diminished ATP levels. Creatine appears to be among the most effective nutritional supplements for maintaining or raising ATP levels.

Recent research indicates that creatine affords the human nervous system significant protection against ischemic and oxidative insults.[43-56] A study published in the *Annals of Neurology* examined creatine's effects on brain tissue damage following simulated traumatic brain injury in animals.[57] Administration of creatine ameliorated the extent of cortical damage by as much as 36% in mice and 50% in rats. The researchers noted that this protection may be tied to creatine-induced maintenance of mitochondrial bioenergetics. They concluded that creatine ". . . may provide clues to the mechanisms responsible for neuronal loss after traumatic brain injury and may find use as a neuroprotective agent against acute and delayed neurodegenerative processes." This study suggests that creatine therapy should be initiated as soon as possible after traumatic brain injury. People who have already been using creatine regularly may be afforded considerable protection against additional brain damage following such an injury.

Research also indicates that creatine improves brain function in healthy adults. A recent double-blind, placebo-controlled crossover study examined how six weeks of creatine supplementation affected cognitive function in adult vegetarians.[58] Subjects were given five grams of creatine daily. Following creatine supplementation, the study participants demonstrated improved scores on tests assessing intelligence and working memory. Creatine's effects may be due to its ability to increase the cellular energy available to the brain. Although creatine supplementation may have a less dramatic effect on non-vegetarians who obtain some creatine from dietary sources such as meat, it is likely that creatine benefits brain function in meat eaters and vegetarians. Supplemental creatine thus appears to improve function and performance in healthy and injured brains alike.

CONCLUSION

Through its role in promoting an abundant pool of cellular energy, creatine helps support the healthy functioning of muscle, brain, and other body tissues. A substantial body of research demonstrates that creatine is a safe and effective tool for managing a wide range of pathologies, and may be a powerful anti-aging nutrient. Healthy adults may benefit from supplementing with two to three grams of creatine daily, while those seeking to address specific health concerns such as muscle loss or brain injury may benefit from five to ten grams of creatine daily.

Additional information on how creatine and other supplements may benefit athletes is available at www.MuscleBuildingNutrition.com.

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