Basic Health Info

Creatine and Energy

By Chet Zelasko, PhD

When we think of energy, we probably think of a nutrient that supplies energy such as carbohydrates or fat. But what if we need energy right now? What can we use?

If we're talking about skeletal muscles to run, jump, or lift an object, we're limited to what's in our muscles right this second; we have a pool of potential energy stored in a molecule called phosphocreatine (PCr). The PCr gives up its phosphate to a molecule called adenosine diphosphate (ADP) to make adenosine triphosphate, also known as ATP. Our mitochondria make ATP, but it's a slower process; if we need energy in an instant, PCr is the source we use. This Health Info includes an overview of creatine, what it's used for in the body, and how it may have a role to play in building muscle and energy.

Creatine is a molecule that can be made in the body with chemical reactions that use the amino acids arginine, glycine, and methionine. While primarily made in the kidneys and liver, we can get creatine from meat and from sports nutrition products that contain creatine monohydrate. Meat is a source because most creatine, more than 95%, is found in the skeletal muscle of animals; if we eat meat, it's generally the skeletal meat we favor.

Instant Energy

In muscle, over half the creatine is stored in the PCr form so it's ready to be converted into energy in an instant. About 2% of the creatine we make is broken down into creatinine for elimination. Based on prior research, we can sustain PCr stores by getting about 3% of our creatine from outside sources: meat or supplements.

When we consider the total amount of muscle mass in a human, a reasonable question is: how much creatine do we store? While the amount would vary, depending on the muscle mass of the individual, a 154-pound (70 kg) healthy, young male would have about 140 grams or about five ounces stored in his body.

The primary purpose of creatine is to make instant energy. There's a time delay when our bodies start using glucose as a fuel and even more so for fat; while it's only a few seconds for glycolysis to kick in, PCr provides us a bridge until other energy systems can be tapped. Hence, the term instant energy.

The remaining creatine is stored in the brain for the most part. It makes sense; in case of some form of trauma, it's available to support energy production if energy can't be made other ways.

Athletic Performance

The most common use of creatine in supplement form is by athletes. The original idea was that by increasing the creatine pool, it would also increase the PCr pool and thus help athletes perform in athletic events that require power and strength such as sprinting, shot putting, and high jumping. In laboratory or field tests of improved performance, creatine supplementation seems to help, but that doesn't seem to have translated to actual sports performance during competitions—at least, nothing that has been reported in the scientific literature.

Another use of creatine is to increase strength. There's a small increase in the water in our muscles during creatine supplementation. Although small, the cross-sectional area of the muscle is larger. Because the force a muscle can generate is proportional to its cross-sectional area, the muscle is stronger, even though it's a temporary strength. That allows the athlete (or you and I) to lift heavier weights and thus increase strength and perhaps size of the muscle as more contractile filaments are made.

Typically, athletes use a three- to five-day loading phase in which they consume 20 grams of creatine per day and then 5 grams per day thereafter. This would be during a building phase where they lift heavy weights to increase strength for four to eight weeks. Further research has shown that the loading phase is not necessary; benefits have been shown by taking three to five grams of creatine monohydrate every day.

Other Uses for Creatine

There has been an interest in whether creatine supplementation may be useful for other reasons. Because of the amount stored in the brain, creatine supplementation has been researched for benefits in neurological conditions such as traumatic brain injury, Huntington's disease, amyotrophic lateral sclerosis (ALS), cerebral ischemia (a type of stroke), and Parkinson's disease. Creatine supplementation has also been researched for potential benefits for osteoarthritis and fibromyalgia. There's much research to be done, not the least of which is the use of creatine to increase muscle mass and strength as we age, perhaps reducing sarcopenia, the loss of skeletal muscle mass and function that accompany aging.

The most interesting study I found was a proof of concept study that used blood flow restriction exercise training together with a blend of supplements including creatine as part of a pre-habilitation program before abdominal cancer surgery. The restriction of blood flow is done by using cuffs similar to blood pressure cuffs that increases the resistance against which blood must be pumped. While there was no control group, the subjects did improve on physical variables related to cardiovascular health. The study did not report how the subjects fared after surgery.

Is Creatine Safe?

The primary concern with creatine use by non-athletes is safety; because creatine is broken down into creatinine and eliminated via the kidneys, the concern is logical. There's no research to suggest that creatine supplementation, with or without additional protein or amino acid supplementation, is harmful to healthy individuals. People with impaired kidney function should contact their healthcare professional for guidance before use.

I would recommend the paper published in the 2021 Journal of the International Society of Sports Nutrition (first reference) for further information regarding safety in which a panel of experts answers common questions and misconceptions about creatine supplementation.

References

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Dr. Chet Zelasko is dedicated to helping men and women get healthy and fit. As a health and fitness consultant with a PhD in Exercise Physiology and Health Education from Michigan State University, he provides health information based on the most recent research and delivers it in a way that's easy to understand. Whether in person during seminars, in audio recordings, or in the written word, he makes sense out of the health news people hear so they can make better health choices and achieve optimal health. He's conducted research and been published in peer-reviewed journals. He is certified by the American College of Sports Medicine as a Health and Fitness Specialist and has taught in ACSM certification workshops throughout the United States; he also belongs to the American Society of Nutrition. Although Grand Rapids, Michigan, is home, he has presented seminars on health to groups all over North America, Mexico, and the Caribbean and has written extensively on the health benefits of a good diet, regular exercise, and targeted supplementation.