

Creatine: Creating Trouble?

By Jenn Abelson

Over the past several years, ergogenic supplements — which aim to enhance work capacity — have secured popularity among both professional and amateur athletes. The recent deaths of three college wrestlers and serious seizures in two other athletes has now prompted the Food and Drug Administration to investigate whether one such supplement, known as creatine, played a role in these unfortunate incidents.

First marketed in America in 1993, creatine supplements have gained a solid foundation of supporters. Promising to enhance short, high-intensity exercise and reduce fatigue, creatine sales jumped from \$3 million in 1996 to \$25 million in 1997, according to Drug Topics magazine. Despite this synthetic muscle-building supplement's popularity, questions remain concerning its safety. Although creatine does not appear on the banned-substance list of the National Collegiate Athletic Association (NCAA) and the United States Olympic Committee (USOC), little research has been conducted both on short and long-term effects.

Creatine is a crystalline nitrogenous compound synthesized in the liver, pancreas and kidneys from amino acids glycine, arginine and methionine. Creatine is stored in the skeletal muscle in the form of creatine phosphate, which acts as a precursor to adenosine triphosphate (ATP) — the main fuel for sprinting or intense weight training. During exercise, ATP loses a phosphate group and becomes ADP. Creatine, when present in the muscle in sufficient amounts, donates a phosphate group to ADP. This causes a rapid transformation to ATP, which is immediately available to the muscle to be used as a fuel for exercise, according to Lisa Schniring in Physician and Sportsmedicine.

The normal daily requirement for creatine is about 2g for a 70 kg person; about half comes from animal protein, and the other half is synthesized by the body. A half-pound of raw meat contains 1g of creatine. To consume the amount shown by research

to have an effect on the body, a person would have to eat anywhere from five to 25 pounds of beef daily — or about one cow per week.

When creatine is supplemented exogenously, phosphocreatine stores rise, and ATP is replenished faster. This creates more energy, allowing a person's muscles to do more work at a higher intensity. Creatine products are available in nutrition and vitamin stores, mail-orders in magazines, and on the web. These supplements come in powders, pills, gum, candy and liquid forms. To achieve ergogenic effects, some manufacturers recommend an initial loading dose of 20gm per day, taken in four divided doses, followed by 5 gm to 10 gm daily throughout the training period, according to Drug Topics.

Once the muscles are saturated with creatine, a maintenance dose can be consumed. Megadoses, however, do not correlate with greater muscle gain: increasing creatine dosage appears to add no benefit since the excess is excreted. "There's a limit to how much creatine muscles can take on, and taking larger doses is just creating very expensive urine," explained Jeff S. Volek MS, RD, a doctoral student in the sports medicine laboratory in the Department of Kinesiology at Pennsylvania State University in University Park. Creatine runs anywhere from \$21 for a 100 gram bottle to \$20 for a 1000 gram bottle. The monthly cost of creatine ranges from \$35 to \$60.

Creatine monohydrate supplement ads online claim that loading creates "phenomenal gains in muscle size, strength and performance in as little as one week" (*AthleticNutrition.com*). Richard B. Kreider, PhD, associate professor and assistant chair in the Department of Human Movement Sciences and Education at the University of Memphis, agreed with this statement, describing creatine's effects as impressive and rapid. "Athletes can gain 1 to 3 lb the first week. Then at 2 weeks, there are significant increases in lean mass ... At 6 weeks, there's an average 10 lb gain in lean mass. Strength gains are equally dramatic" Kreider said.

In Consultant magazine, Sandra B. Leonard and Elaine B. Feldman explained that creatine supplements are recommended as an ergogenic aid for athletes who perform

repeated bouts of strenuous, high-intensity exercise or brief, maximal exercise. This lets sprinters keep going flat-out a little longer and recover from the stress of the exercise a little faster. Creatine supplementation may also benefit athletes, such as body builders, weight lifters and football linemen, who participate in resistance training programs by allowing them to complete workouts at a higher intensity with less fatigue. According to Schniring, several studies have shown that short-term creatine supplementation increases phosphocreatine stores in muscle by 10 to 40 percent.

"In acute studies – looking at the effects of a creatine loading regimen – our results confirm the positive effect on performance and increased body mass, increased fat-free mass, and increased strength," said Volek, who has been researching creatine's effects since 1995. Gains in muscle mass are thought to occur from fluid retention and/or stimulation of protein synthesis. Creatine can bind water to the muscle giving an athlete a more muscular appearance, making the muscles look "fuller" or more "pumped."

Although double-blind, placebo-controlled studies, which generally involved young, athletically trained men, have indicated a rapid, short-term benefit of creatine, objective studies have not lasted more than eight weeks, so evidence of long-term efficacy is lacking, according to a 1998 Consumer Reports.

In addition, not all short-term research has confirmed the ergogenic effects of creatine supplementation, however. An analysis of the studies suggests that individuals may vary in their response to creatine and that supplementation appears to be less effective under certain circumstances — smaller doses and shorter loading periods. The studies on running and swimming are less consistent in their conclusions as well, possibly because the weight gain slows athletes down.

Kreider rejects the idea that creatine gives athletes an unfair advantage, saying, "Creatine use is based on the same principle as carbohydrate loading." Furthermore, detecting these supplements is much too difficult. According to Volek, creatine testing requires a muscle biopsy.

Kreider cited weight gain as the only documented side effect of creatine supplementation. He said unpublished anecdotal reports about side effects have linked creatine use to muscle strains, pulls, cramps and renal failure. According to the , a depletion of electrolytes causes the cramping associated with creatine. Other unconfirmed effects include dehydration, gastrointestinal distress, dizziness, headaches and seizures.

Although a 1997 study showed that short-term creatine use (20 g per day for 5 days) did not increase markers of renal stress in five healthy men, a recent case report described a 25-year-old man who developed renal dysfunction while taking creatine supplements, and then regained renal function when he stopped taking them.

Although proven largely successful in the short-term use, the supplement has not been studied for long-term effects. Researchers have raised concerns about the long-term effects of creatine use on the kidney and liver: "the kidney because it must clear higher levels of creatine, and the liver because it, along with the pancreas and kidneys, stops making endogenous creatine during supplementation" Schniring reported.

The recent death of three college wrestlers and serious seizures in two other athletes compelled the Food and Drug Administration to investigate whether creatine played a role in these incidents. Although the Center for Disease Control and Prevention in Atlanta did not implicate creatine use as a contributing factor, the FDA has not yet released its report. While studies have confirmed the short-term benefits on creatine supplementation — boosting strength levels, enhancing gains in muscle strength and size and preventing muscle tissue breakdown that can occur subsequent to strenuous exercise — controversy over creatine's short and long-term effects, as well as the ethics of using supplements, persists. □