



CREATINE

By Emily Murray, MS, RD, LDN

HEALTH CLAIMS

Creatine (Cr) is marketed as "nature's muscle builder" and provides immediate energy production during high-intensity workouts (1). Cr is considered the most studied and used sports supplement. Athletes take this ergogenic aid hoping to increase their strength and performance. Cr supplementation is claimed to increase muscle power by playing a role in the transfer of energy to help the muscle contract (2). Claims are also made that supplementation increases muscle body mass (1).

The supplement industry puts a lot of time and money into marketing Cr. A website, www.creatinesupplementguide.com, makes the following claims regarding Cr (3).

- Increased power during workouts.
- Less dependence on glycogen for energy, therefore less build-up of lactic acid.
- More available energy, which leads to faster muscle growth.
- 100% natural product, not a drug or a steroid.

A sales person at The Vitamin Shoppe in New York City agreed with the above claims. He also stated that it was used by many athletes and was a "natural steroid."

Health-food stores sell Cr supplements in capsule, chewable, and powdered form. Two popular dosing methods exist for taking Cr. The first is rapid loading method - 20 g of Cr daily, in 4 doses of 5 grams each, for 4 to 5 days. Then to maintain muscle Cr levels after this rapid loading period, 2–10 g per day. The second method is the gradual method - 2 to 3 g of Cr daily over an extended training period of at least four weeks (4).

CREATINE BACKGROUND

Cr is a nonessential nitrogenous amino acid derivative found in beef and fish. It is also naturally synthesized in the body from arginine, glycine, and methionine, primarily in the liver and kidneys. Cr is stored in the muscle as free Cr or phosphorylated creatine (PCr). During exercise muscles need adenosine triphosphate (ATP) to contract, and the ATP in the muscle becomes depleted within second. ATP is regenerated when PCr donates a phosphate molecule that combines with adenosine diphosphate ADP (5). The overall benefits of dietary Cr supplementation on muscle performance is generally attributed to an increase in phosphocreatine resynthesis at rest, allowing for greater ATP availability during repeated bouts of high intensity short duration exercise (6).

In general, Cr supplementation is not believed to assist in aerobic or moderate-intensity long-duration exercise (6). The most common side effects of Cr supplementation is weight gain (fluid), cramping, nausea, and diarrhea. Cr is generally considered safe for healthy adults, despite anecdotal reports of dehydration, muscle strains/tears, and kidney damage (7). The purpose of this paper is to determine if evidence based research supports the current claims made about Cr



supplementation. Two review articles and four studies are reported in this paper. Based on these studies and other supporting literature, it appears Cr supplementation is an ergogenic aid.

RESEARCH

Several studies support Cr being effective in repeated short burst high intensity activity sports. Bembien et al. reviewed over 25 recent studies associated with Cr ingestion and exercise performance (8). The literature review found Cr supplementation improved activities that involve jumping, sprinting or cycling (8). However, this review found little evidence to support the use of Cr for isometric muscular performance and the prevention or suppression of muscle damage or soreness. Bembien et al. also reported no strong evidence to support adverse side effects (8).

One study that looked at the effects of Cr supplementation on well trained male sprinters was published in the *Scandinavian Journal of Medicine & Science in Sports* in 2001 (9). 18 male track sprinters, were randomly assigned to 20 g Cr plus 20 g glucose per day (Cr group, n=9) or 40 g glucose per day (placebo group, n=9). The effect of Cr on sprint performance was evaluated in two tests, a 1 x 100 meter sprint and an intermittent 6 x 60 meter sprint. There was a significant increase in the 100 meter sprint performance (11.68 \pm 0.27 s compared to 11.59 \pm 0.31 s) and repeated sprint performance (45.63 \pm 1.11 s compared to 45.12 \pm 1.1 s). The placebo group had no improvement for pre and post conditions. The improved sprint performance suggests an increased availability of energy, possibly as a result of increased skeletal muscle PCr (9).

A strength of this study was venous blood was drawn 5 minutes after finishing the final intermittent 60 meter run. Plasma lactate, Cr and serum creatinine were all increased in the Cr group compared to presupplementation values. No changes were observed in the placebo group. Limitations of the study were small sample size and all participants were male.

Another study that supports the use of Cr supplementation was conducted by Wirth et al. (10). This study examined the potential ergogenic effects of Cr supplementation on maximal pedaling performance. The 45 participants were divided into three groups (G1 = sedentary, n=14, mean age 70.1 years; G2= trained cyclist, n=14, mean age 66.4 years; and G3 = young sedentary, n = 14, mean age 26.0 years). In each group, double-blind randomization was carried out. One half was given Cr (3 x 5 g/day), and the other was given an iso-nitrogenated placebo (3 x 10g/day). Before and after the 5 days during which the supplements were given, all subjects performed 5 all-out 10s sprints separated by 60s intervals of passive recovery. Power output, work done and heart rate data were recorded during each sprint.

The elderly and the young sedentary subgroups that were given Cr showed significant ($p<0.05$) improvements in maximal power (+3.7% and + 2.0%, respectively) and work done (+4.1% and + 5.1%, respectively). No significant change in pedaling performances was observed in the trained elderly subjects. The Cr did not change the exercise and recovery heart rate profiles, in any group. Wirth et al. suggested that Cr supplementation increases the anaerobic power and work capacity of sedentary people of different ages during maximal pedaling tasks (10). However, the level of physical activity seems to be a determinant of the ergogenic effect of Cr in older subjects. It is possible that the increased training status of the trained cyclist may reduce the response to Cr



loading. A strength of this study was it looked at the older population. As with other studies a limitation was a small sample size and it only included men.

Bemben et al. also conducted a double-blind study that looked at the effects of Cr supplementation during resistance training in college football athletes (11). This study assessed the effects of a 9 week regimen of Cr monohydrate supplementation, coupled with resistance training on body composition and neuromuscular performance in NCAA Division I football players. Cr regimen consisted of 20 g/day for 5 days along with a maintenance phase 5 g/day for the duration of the study. The 25 participants were randomly assigned to a treatment (Cr, n = 9), placebo (P, n = 8), or control group (C, n = 8). During the study participants keep food records that were analyzed. All athletes resistance trained 4 days during the first week of the study. Measurements of neuromuscular performance and body composition were made pre- and post-training after supplementation.

The study found significant differences between Cr supplemented group and the other two groups. In the Cr group, body weight in kilograms increased by an average of 3.5% and lean body mass increased by 3.8% (11). Strength also improved for the Cr group for bench presses, power cleans and squats (5.2%, 3.8% and 8.7%, respectively). Anaerobic power and capacity, measured by Wingate bicycle ergometer test also improved (19.6% and 18.4%, respectively). However, percent body fat, peak torque during knee flexion and extension, global muscular strength (power clean), and extracellular fluid remained statistically unchanged for all groups.

Findings indicate that Cr supplementation, in conjunction with resistance and anaerobic training, may positively affect cell hydration status and enhance performance variables (11). Bemben et al. suggest that Cr athletes gained weight and lean mass due to an increase in total body water, in the form of intracellular fluid. They suggest that Cr draws water into the intracellular fluid, which then may aid in protein and glycogen synthesis (11). A strength of this study was various measurement tools were used.

Bemben et al. and other studies that look at intercellular fluid have led to questions regarding dehydration and muscle cramps with Cr supplementation. Cr is known to be an osmotically active substance that draws water into cells. Some research theorized that Cr supplementation could result in fluid balance shifts, where more water could be retained intracellularly and therefore be unavailable for thermoregulation.

Dalbo et al. reviewed 12 current studies regarding muscle cramps and dehydration and found little evidence exist that Cr supplementation in heat presents additional risks (12). Delbo et al. suggest that Cr supplementation “decreases the risk of dehydration by increasing total body water, lowering exercise core body temperature and reducing exercise hearth rate and sweat rate” (12).

A study by Weiss et al. looked at effects of Cr supplementation on resting body water volumes and on core temperature and sweat loss during a bout of exercise in a warm environment (13). The study consisted of 24 aerobically trained male athletes. Prior to supplementation each subject was assessed for resting body water volumes and for body mass, heart rate blood pressure, and core temperature immediately before and following a 60 min bout of exercise in a warm environment. Then particulates were place in a Cr or placebo group. Each subject returned



following a 5 day supplementation period and was reassessed using identical testing procedures. The Cr group experienced a significant increase in intracellular, extracellular and total body water. No changes in core temperature or sweat loss were observed in either group. Weiss et al. concluded that Cr loading did not impair the thermoregulatory response during a bout of exercise in the heat (13).

CONCLUSIONS AND APPLICATIONS

The research is fairly convincing that Cr does enhance performance in activities that involve repeated short bouts of high-intensity anaerobic activity. Studies have shown that Cr can increase cell hydration status, which can result in weight gain, not increased muscle mass. Recent studies show that Cr supplementation does not lead to dehydration and muscle cramps. However, there are anecdotal reports of dehydration, muscle strain/tears and kidney damage. While there seems to be some positives benefits to Cr supplementation, long-term use of Cr is unknown.

The American Dietetic Association recommends that health care professionals “carefully screen athletes using Cr for any risk of liver or kidney dysfunction or in rare instances, anterior compartment syndrome” (7). It is important to remind clients that even though Cr is a naturally occurring substance; anything in excess can be detrimental. Also, Cr supplements are not subject to a certification process conducted by the FDA, therefore purity and safety are not assured.

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