



Background

Creatine is a non-protein nitrogen compound that can be either ingested—through dietary sources such as meat, poultry, and fish—or made—by the liver, kidneys, and pancreas—from the non-essential amino acids arginine, glycine, and methionine.¹ Approximately 95% of the body's total creatine content (120 to 140 g for an average 70 kg person) is located in skeletal muscles, with a greater concentration in Type II (fast twitch) compared to Type I (slow twitch) muscle fibers.¹ The remaining 5% is located in the brain, heart, and other tissues.² Creatine is converted in skeletal muscle to creatinine and then filtered by the kidneys at a rate of ~1-2 g/day for excretion in urine.³

Creatine typically exists in one of two forms in the body: free creatine, which accounts for approximately 40%, and creatine phosphate (CP), which accounts for the rest.⁴ Creatine phosphate participates directly in energy production and serves as the cells' energy reservoir to provide rapid phosphate-bond energy to resynthesize adenosine triphosphate (ATP) from adenosine diphosphate (ADP) and phosphate—part of the metabolic process within the body. Creatine and CP also act to shuttle high-energy phosphates to initiate and maintain muscle action.⁵

Dose Range and Upper Limit

Food and Nutrition Board DRI:

RDA/AI: Not established.

Upper Limit (UL): Not established. However, the Observed Safe Level for regular, continuous intake is five grams per day.^{6,7}

Doses Used In Randomized Clinical Trials: Several dosing regimens have been used to assess improvements in performance parameters such as enhanced body composition, strength, power, speed, and thermoregulation in population groups such as military, athletes, and healthy adults. Some studies used a loading dose of 20 g/day for up to one week followed by a maintenance dose of 3-5 g/day; others used 2-5 g/day for several weeks.^{7,8}

Toxicology Data: Evidence suggests that oral creatine supplementation at 2-3 g/day is a safe and sufficient dose to maximize muscle creatine levels.⁹

Evaluation of Potential Benefits

Creatine can enhance performance of short-term bouts of high-intensity training activities and can increase muscle mass.⁶ However, there is little or no evidence of improvements in endurance or aerobic performance.¹ It may have some psychological benefits on cognitive and psychomotor performance and mood state.¹⁰

Potential Detrimental Effects on...

Military Performance: Increased pressure may occur within the lower leg muscles, which may result in aching, cramping, and burning of the lower leg.¹¹⁻¹³ The most common side effect is weight gain; the amount depends on length of use and dosing.⁸

Military Survivability: Creatine can cause muscle cramping and reduce hydration status.⁸

Other Health Risks

No serious adverse effects or health risks have been noted from creatine supplementation for up to five years at recommended levels. Anecdotal reports and case studies include muscle cramping, gastrointestinal disturbances, renal (kidney) dysfunction, hypertension, dehydration, and heat intolerance.^{3,6,9}

Interactions with Medications or Other Bioactive Substances

Caffeine seems to eliminate the performance-enhancing benefits of creatine.¹³

Combining carbohydrates with creatine can increase muscle creatine levels more than consuming creatine alone.¹⁴

There is an isolated report of ischemic stroke in an athlete who took creatine in combination with caffeine and ephedra.⁸

For details of these and other potential interactions, visit the Natural Medicines Comprehensive Database.⁸

Withdrawal Effects

No data found.

Concern and Benefit Estimate (see Dietary Supplement Risk Matrix)

Benefit potential: Moderate

Risk (safety concern): Low

Classification score: **4**

Creatine can enhance performance of short-term bouts of high-intensity activities with training as well as increases in muscle mass.⁶ However, it is doubtful if it improves overall endurance or aerobic performance.

References

1. Bemben MG, Lamont HS. Creatine Supplementation and Exercise Performance - Recent findings. *Sports Med.* 2005;35(2):107-25.
2. Juhn MS, Tarnopolsky M. Potential Side Effects of Oral Creatine Supplementation: A Critical Review. *Clin. J. Sport Med.* 1998;8(4):298-304.
3. Buford TW, Kreider RB, Stout JR, Greenwood M, et al. International Society of Sports Nutrition position stand: creatine supplementation and exercise. *Journal of the International Society of Sports Nutrition.* 2007;4(6):8.
4. Demant TW, Rhodes EC. Effects of Creatine Supplementation on Exercise Performance. *Sports Med.* 1999;28(1):49-60.
5. McArdle WD, Katch FI, Katch VL. *Exercise Physiology: Energy, Nutrition, & Human Performance.* 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2007.
6. Committee on Dietary Supplement Use by Military Personnel. *Use of Dietary Supplements by Military Personnel.* Washington, DC: Food and Nutrition Board, Institute of Medicine; 2008.
7. Shao A, Hathcock JN. Risk assessment for creatine monohydrate. *Regul. Toxicol. Pharmacol.* 2006;45(3):242-51.
8. Jellin J, Gregory, PJ, eds. *Creatine.* Natural Medicines Comprehensive Database 2011; <http://www.naturaldatabase.com/>.
9. Poortmans JR, Rawson ES, Burke LM, Stear SJ. A-Z of nutritional supplements: dietary supplements, sports nutrition foods and ergogenic aids for health and performance Part 11. *Br. J. Sports Med.* 2010;44(10):765-6.
10. McMorris T, Harris RC, Swain J, Corbett J, et al. Effect of creatine supplementation and sleep deprivation, with mild exercise, on cognitive and psychomotor performance, mood state, and plasma concentrations of catecholamines and cortisol. *Psychopharmacology.* 2006;185(1):93-103.
11. Hile AM, Anderson JM, Fiala KA, Stevenson JH, et al. Creatine Supplementation and Anterior Compartment Pressure during Exercise in the Heat in Dehydrated Men. *J. Athl. Train.* 2006;41(1):30-5.
12. Pottleiger JA, Randall JC, Schroeder C, Magee LM, et al. Elevated Anterior Compartment Pressure in the Leg After Creatine Supplementation: A Controlled Case Report. *J. Athl. Train.* 2001;36(1):85-8.
13. Vandenberghe K, Gillis N, Van Leemputte M, Van Hecke P, et al. Caffeine counteracts the ergogenic action of muscle creatine loading. *J. Appl. Physiol.* 1996;80(2):452-7.
14. Green AL, Simpson EJ, Littlewood JJ, MacDonald IA, et al. Carbohydrate ingestion augments creatine retention during creatine feeding in humans. *Acta Physiologica Scandinavica.* 1996;158(2):195-202.