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**For information contact:**

**Nick Tumminello**

**[NickTumminello@gmail.com](mailto:NickTumminello@gmail.com)**

**Manual Layout**

Nick Tumminello

**Editing**

Lou Schuler

**Cover Design**

Dane Davenport – Designed Inc. 816-789-3871

**Special Thanks to:**

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**[Jim Stoppani](#)**

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## About the Author



Coach Nick Tumminello has become known as the “trainer of trainers.” He’s the owner of Performance University International, which provides [hybrid strength training & conditioning](#) for athletes and educational programs for fitness professionals all over the world. He’s also the hybrid training expert for Team Jaco clothing &

PowerMax 360.

Nick lives in Fort Lauderdale Florida where he trains a select group of physique to performance athletes and teaches professional mentorships.

You can check out his DVDs, seminar schedule, educational programs, articles and very popular hybrid fitness training blog at [NickTumminello.com](http://NickTumminello.com).

## About the Editor



Lou Schuler, C.S.C.S., is a journalist and author or coauthor of many popular books about strength training and nutrition, including *The New Rules of Lifting for Life* (Avery, April 2012) with Alwyn Cosgrove.

A former fitness editor of *Men’s Fitness* magazine and fitness director of *Men’s Health*, he’s contributed to a long list of newspapers and magazines, including *Shape*, *Men’s Journal*, *Better Homes & Gardens*, and *Fit Pregnancy*.

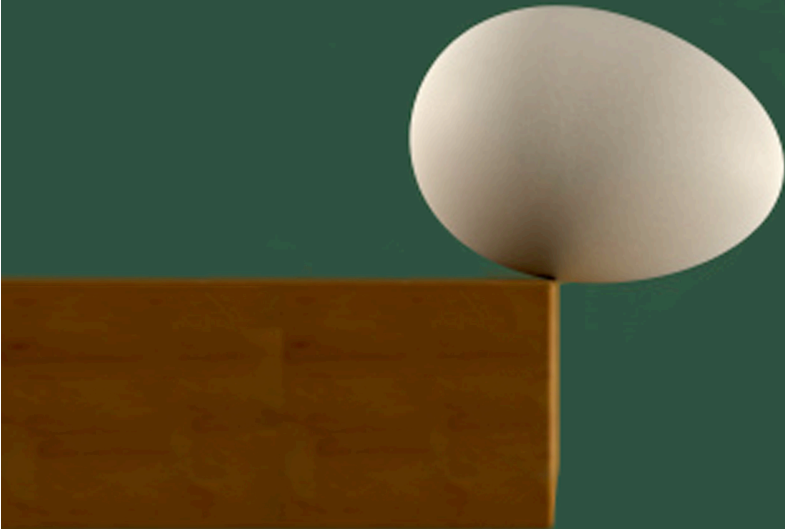
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WRITTEN BY NICK TUMMINELLO  
NICKTUMMINELLO.COM



EDITED BY LOU SCHULER  
LOUSCHULER.COM

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# All Your Creatine Questions Answered

**Wondering what's the best kind? How to use it? How it works? Here are your answers to those questions, and many more**

*"To date, creatine is clearly the single most effective dietary supplement for enhancing gains in anaerobic performance as well as increasing lean body mass and muscle fiber size."* Jose Antonio, Ph.D., owner, International Society of Sports Nutrition

I recommend creatine to almost all my clients and athletes. Why? It's cheap, it's safe, it works fast, and it's backed up by solid research. In this special report, I'm going to cover these topics:

- What creatine is
- What it does
- Why it works
- How it works
- Who should use it
- How to use it
- How much to take
- How, when, and why to load creatine
- How to cycle it
- How much water to drink while using creatine
- The best type of creatine
- The safety and potential side effects of creatine
- Whether creatine is safe for children

## Special thanks

I like to think I'm at the forefront when it comes to the strength and conditioning. I know what the cutting-edge researchers and practitioners are talking about. I'm

familiar with the latest techniques. I can argue with anyone about the current controversies.

But when the conversation turns to nutrition, I'm certainly not the expert. I'm a student.

The information I've included here comes from three friends and colleagues: Jose Antonio, Ph.D., CEO of the ISSN; David Sandler, director of education for the NSCA; and Alan Aragon, a nutrition consultant who works with a broad range of clients and is regularly quoted in magazines like *Men's Health*. Their articles and presentations provided me with the information and research I'm about to share with you.

# Part 1: What creatine is, and how it works

## What is creatine?

Here's what you need to know:

- Derived from the amino acids glycine, arginine, and methionine
- Synthesized mainly in the liver and kidneys (and to a lesser extent in the pancreas)
- Stored primarily as free creatine, or bound to a phosphate molecule in skeletal muscle
- Skeletal muscle contains 95% of all creatine
- The heart, brain, and testes hold the remaining 5%

Terrillon K. Int J Sports Nutr 7:138, 1997; Volek JS & W.J. Kraemer. J Strength Cond Res 10:200, 1997

## What does creatine do?

Strength coach David Sandler sums up the benefits of creatine supplementation:

“Creatine allows you to have a longer and larger work volume. It helps you get one more rep. Supplementation can increase phosphocreatine and creatine stores by 10 to 40%.”

Increased PCr stores improves the ability of your muscles to resynthesize ATP from ADP following high-intensity, short-duration exercise. Kreider RB et al. JEP online 1.1, 1998

Specifically, research has shown that creatine offers these benefits:

- Increases fat-free mass
- Improves maximal strength (as measured by 1RM bench press)
- Improve muscular endurance
- Increases anaerobic power and performance (shown in many activities, including continuous jumping, jump squats, knee extensions, and repeated sprints by soccer players)
- Helps keep you hydrated in extreme outdoor conditions

Creatine supplementation (6 g/d for 12 weeks) during resistance training resulted in increased fat-free mass, thigh volume, muscle strength, myofibrillar protein content, and Type I, IIa, and IIx MHC mRNA expression compared to

controls. Willoughby et al. MSSE: 33: 1674-81, 2001

Increase in total-body mass and lean mass with no gain in fat. Balsom P et al. Acta Physiol Scand 1995;154:303;  
Grindstaff PL et al. Int J Sport Nutr. 1997; 330-346; Vandenberghe K et al. JAP 1997;83:2055

Increased Type I and II muscle fiber hypertrophy Sim L et al. CJAP 23(5): 507, 1998; Volek et al. 1999

Effect of creatine supplementation on aerobic performance and anaerobic capacity in elite rowers in the course of  
endurance training. Chwalbinska-Moneta J. Int J Sport Nutr Exerc Metab. 2003 Jun; 13(2): 173-83

The effects of creatine supplementation on cardiovascular, metabolic, and thermoregulatory responses during exercise in  
the heat in endurance-trained humans. Kilduff LP et al. Int J Sport Nutr Exerc Metab. 2004 Aug; 14(4): 443-60

Bosco C et al. Int J Sports Med 1997; 18:369

Greenhaff PL et al. Clin Sci 1993; 84:565

Harris RC et al. J Physiol 1993; 467:74P

Balsom PD et al. Scan J Med Sci Sports 1993; 3:143

Balsom PD et al. Acta Physiol Scand 1995; 154:303

Birch R et al. Eur J Appl Physiol 1994; 69:268

Earnest CP et al. Acta Physiol Scand 1995; 153:207

Mujika I et al. Med Sci Sports Exerc 2000; 32:518-25

Chwalbinska-Moneta J. Int J Sport Nutr Exerc Metab. 2003 Jun; 13(2): 173-83

## **Can creatine help with fat loss?**

When one of my athletes needs to lose fat, our first and most effective tactic is to lengthen his sets and shorten his rest periods, with the goal of doing more work in a defined amount of time. It burns more calories both during and after the workout, thanks to a phenomenon called EPOC (excess post-exercise oxygen consumption). The harder you can work, the greater the effect.

We know from the research already cited that creatine helps you get an extra rep or two per set, and also leads to strength increases that allow you to use heavier weights throughout your workouts. You work more *and* work harder, giving you two powerful tools for fat loss.

We also know that creatine helps you gain and retain metabolically active lean muscle tissue. Put simply, the more muscle you have on your body, the harder you can work in the weight room, and the more calories you can burn both during and after your training sessions.

(If you want to see examples of my go-to workouts for body composition, check out my [\*Strength Training for Fat Loss DVD\*](http://nicktumminello.com), available at my website, [nicktumminello.com](http://nicktumminello.com).)

Creatine also helps elevate your metabolism more directly, through its hydration properties. "A well-hydrated cell tends to be more metabolic," Antonio says.

### **Can creatine improve endurance?**

"Unlike creatine's consistent benefit for strength and power sports, its track record in the scientific literature for improving endurance is a mixed bag of positive and negative results," Aragon says. Does that mean creatine is useless for all endurance sports? Not at all, Aragon says. Many of those sports are performed at a mix of intensities. "Any type of training that combines brief bursts of high-intensity output with prolonged steady-state work can potentially benefit from creatine supplementation, as long as net weight gains don't neutralize performance," he explains. "In the case of endurance athletes, it's really an individual matter of trying it out and seeing if it benefits your individual sport."

## **Part 2: How to use creatine**

### **What type of creatine is best?**

There are several kinds available:

- Creatine monohydrate
- Creatine ethyl ester
- Creatine phosphate
- Creatine citrate

I recommend creatine monohydrate to my clients and athletes. More specifically: micronized creatine monohydrate.

“Creatine monohydrate is definitely the way to go,” Alan Aragon says. “Not only is it less expensive than other forms, it’s actually been shown to have better bioavailability.” Other forms of creatine marketed as superior to monohydrate have been shown to rapidly degrade into the inert waste product called creatinine, while regular creatine monohydrate maintains its active form, and thus its effectiveness. Aragon adds that you want to make sure the product you get has the Creapure seal. That way you know you’re getting the highest-quality creatine available.

Kre-alkalyn® supplementation has no beneficial effect on creatine-to-creatinine conversion rates. Tallon MJ, Child R.

Creatine ethyl ester rapidly degrades to creatinine in stomach acid. Child R, Tallon MJ.

Presented at the 4th International Society of Sports Nutrition (ISSN) annual meeting.

Both studies were presented at the 4th International Society of Sports Nutrition (ISSN) annual meeting.

### **How much should I take?**

The research shows benefits with doses ranging from 3 to 6 grams per day. More isn’t better; once your muscles are saturated, your body gets rid of the excess.

### **Do I need to do a “loading” period?**

Maybe yes, maybe no. It depends on how fast you'd like to see results. “If you’re seeking a fairly rapid improvement in anaerobic performance and lean body mass, it would be sensible to do a loading phase with creatine,” Antonio says. If time isn’t an

issue, Antonio recommends taking a maintenance dose every day, which should fully saturate your muscles within a month.

If you decide to load, experts recommend 20 grams a day for 7 to 14 days.

### **Do I need to take creatine with a carbohydrate source?**

Fifteen years ago, the answer was “yes.” Everyone was told to take their creatine with fruit juice or some other carbohydrate-rich drink. Today, it depends on your training goal.

“The use of high-glycemic sugars to potentiate the uptake of creatine has good support in the scientific literature,” Antonio says. But a high dose of liquid carbs may not be the best choice for your waistline.

Thus, if your main goal is low body fat, or if you’re a power athlete in a weight-class sport, you’ll want to use creatine without the sugar. Antonio says you’ll still get significant elevations in total intramuscular creatine concentrations. At worst, it won’t happen as fast.

Alan Aragon also notes that no one needs to take creatine with carbs once they’re past the loading stage, or after they’ve been taking maintenance doses for at least a month. At that point your muscles are fully saturated, and the carbs are just extra calories.

### **Should I cycle creatine, or use it continuously?**

Most people don’t have to worry about this issue. Continual use offers continual performance benefits. However, fighters and other weight-class athletes may need to cycle off creatine from time to time. Creatine helps your cells retain water, which is good for performance. But it does give you a higher body weight.

I recommend cycling off creatine 6 weeks before a weigh-in.



## Part 3: The effects of creatine on health and well being

In the time I've been training athletes, I've noticed an increasing interest in health. Ten or 15 years ago, I rarely heard a physique competitor talk about the long-term health consequences of his or her training and diet. Partly it's because young athletes feel invulnerable. But also I think society correlated outward appearance with health. If you look good, you must also be healthy.

Today we all know it's more nuanced than that. Someone who looks great on the outside can feel bad, due to chronic injuries, overtraining, or poor dietary choices. We've known or heard of athletes who died at ridiculously young ages. Sometimes these premature deaths come from undiagnosed genetic conditions, but in other cases the deaths were avoidable.

The athletes themselves are acutely aware of this. They ask more questions than ever about how their dietary choices, particularly their dietary supplements, will affect their health. What's the point of being stronger, leaner, and better looking than almost anyone else if you can't live long enough to enjoy it?

Some of the surprising health benefits of creatine:

- Fights inflammation following muscle-damaging exercise
- Improves brain performance
- Improves long- and short-term memory for vegetarians
- Speeds recovery in patients with chronic obstructive pulmonary disease
- Helps mitigate symptoms for those with neuromuscular disorders
- Prevents DNA mutations in aging cells

"Clinical and therapeutic use of creatine is a very interesting emerging area in the research," Aragon notes. For example, a recent study showed that creatine improves glycemic control in type 2 diabetics. "It's also been shown to benefit those with knee osteoarthritis."

Creatine in Type 2 Diabetes: A Randomized, Double-Blind, Placebo-Controlled Trial. Gualano B et al. Med Sci Sports Exerc. 2011 May; 43(5):770-8

Beneficial effect of creatine supplementation in knee osteoarthritis. Neves M Jr. et al. Med Sci Sports Exerc. 2011 Feb 8. [Epub ahead of print]

Creatine supplementation reduces plasma levels of pro-inflammatory cytokines and PGE2 after a half-ironman competition. Bassit RA et al. Amino Acids 2008 Aug; 35(2):425-31

Oral creatine monohydrate supplementation improves brain performance: a double-blind, placebo-controlled, cross-over trial. Rae C et al. Proc Biol Sci. 2003 Oct 22; 270(1529):2147-50

The influence of creatine supplementation on the cognitive functioning of vegetarians and omnivores. David Benton and Rachel Donohoe. British Journal of Nutrition 2011; 105: 1100-1105

Creatine improves health and survival of mice. Bender A et al. Neurobiol Aging 2008 Sep; 29(9):1404-11

Clinical use of creatine in neuromuscular and neurometabolic disorders. Tarnopolsky MA. Subcell Biochem. 2007; 46:183-204

Creatine supplementation during pulmonary rehabilitation in chronic obstructive pulmonary disease. Fuld JP et al. Thorax 2005 Jul; 60(7):531-7

Creatine supplementation normalizes mutagenesis of mitochondrial DNA as well as functional consequences. Berneburg M et al. J Invest Dermatol. 2005 Aug; 125(2):213-20

## Part 4: Creatine side effects

You've probably heard the scary stories about creatine. Kidney damage! Muscle tears! Cramps! Funny thing is, no research has shown creatine to have any side effects at all, other than weight gain. For most athletes who use creatine, that's a feature, not a bug.

Here's the research debunking the scare tactics.

### Does creatine cause cramps or muscle injuries?

According to research at Baylor University, "The incidence of cramping or injury in Division IA football players was significantly lower or proportional for creatine users compared with nonusers."

Greenwood M et al. J Athl Train. 2003 Sep; 38(3):216-219.

Long-term creatine supplementation does not significantly affect clinical markers of health in athletes. Kreider R et al. Mol Cell Biochem. 2003 Feb; 244(1-2):95-104.

### Does creatine adversely affect your kidneys?

Many studies show no negative effects:

- Looking at doses ranging from 3 to 30 grams per day over periods ranging from 10 months to 5 years, "Neither short-term, medium-term, nor long-term oral creatine supplements induce detrimental effects on the kidney in healthy individuals."
- Looking at subjects who were either given 10 grams a day or a placebo for 3 months, "Creatine supplementation over 3 months does not provoke any renal dysfunction in healthy males undergoing aerobic training." The same study suggests that moderate aerobic training by itself may improve renal function.

Long-term oral creatine supplementation does not impair renal function in healthy athletes. Poortmans JR and Francaux M. Med Sci Sports Exerc 1999 Aug; 31(8):1108-10

Effects of creatine supplementation on renal function: a randomized, double blind, placebo-controlled clinical trial. Gualano B et al. Eur J Appl Physiol. 2008 May; 103(1):33-40. Epub 2008 Jan 11

Borsheim E et al. Int J Sport Nutr Exerc Metab 2004 June; 14:255-71

Williams MB et al. J Strength Cond Res 2003 Feb; 17:12-9

## **Does creatine cause dehydration, muscle tightness, strains, or other injuries?**

This is from an article on Antonio's website (see below for links):

“During one season of NCAA Division IA football training and competition, it was discovered that creatine users had significantly less cramping; heat illness or dehydration; muscle tightness; muscle strains; and total injuries than nonusers. Thus, even for athletes who are well-trained, it is clear that regular creatine consumption does not cause harm, and in fact may have a protective effect against certain exercise-related maladies.”

Blomstrand E et al. Eur J Appl Physiol Occup Physiol 1991; 63:83-8

Greenwood M et al. J Athl Train. 2003 Sep; 38(3):216-219

Kreider R et al. Mol Cell Biochem. 2003 Feb; 244(1-2):95-104

The following comes from Brad Schoenfeld's website, in response to a report claiming that creatine is related to a specific type of injury:

“A recent article in the *New York Daily News* suggested that the dietary supplement creatine may be linked to the current oblique injury epidemic. According to Lewis Maharam, a sports physician and former president of the New York chapter of the American College of Sports Medicine, creatine ‘adds water molecules to muscle fibers, which causes the fibers to separate. This makes for easier muscle tears and slows the repair process, leaving them on injured reserve longer.’

“These are some bold claims. However, with all due respect to Dr. Maharam, I could not locate one peer-reviewed study that even suggests such a cause-effect relationship. Sure, creatine increases intracellular hydration, but this shouldn't pose any negative effect on muscle tissue. In fact, studies show that increasing water content in a cell has a positive impact on cellular integrity. Hydration-induced cell swelling causes both an increase in protein synthesis and a decrease in protein breakdown, which ultimately strengthens the cell's ultrastructure (1). If Dr. Maharam or anyone else has evidence to the contrary, I would certainly like to see it.”

This is from the study Brad cites in his post:

“Alterations in cellular hydration not only contribute to metabolic regulation, but also critically determine the cellular response to different kinds of stress. Whereas cell swelling triggers anabolic pathways and protects cells from heat and oxidative challenge, cellular dehydration contributes to insulin resistance and catabolism and increases the cellular susceptibility to stress induced damage.”

The Cellular Hydration State: A Critical Determinant for Cell Death and Survival. Schliess F and Häussinger D. Biological Chemistry 2002 March-April; 383(3-4): 577–583

## **Part 5: Creatine and kids under 18**

### **Is creatine safe for children?**

There's a long history of using creatine supplements with children, even infants. A very small number of kids are born with an inborn error of creatine metabolism. It's extremely rare, but if left untreated the child could end up with severe neurological problems, as well as cognitive problems like mental retardation or autistic disorders.

Some of these children have been treated successfully with creatine monohydrate. One patient was given 4 to 8 grams a day for 25 months, the equivalent of 80 to 160 grams a day for an adult. The patient experienced significant improvement, with brain and total-body creatine rising to normal levels.

As David Sandler says, "Some of the first research studies on creatine were done on overly weak infants. So, yeah, it's safe."

Creatine replacement therapy in guanidinoacetate methyltransferase deficiency, a novel inborn error of metabolism. Stockler S et al. Lancet 1996 Sep 21; 348(9030): 789-90

### **Are there any other conditions in which creatine helps children?**

Yes, creatine has been used successfully in kids with muscular dystrophy. In one study, kids who took creatine monohydrate for four months gained strength and muscle mass, experienced less bone breakdown, and had no side effects.

It's also been used on pediatric cancer patients undergoing chemotherapy. The corticosteroids they take to alleviate the side effects of the chemo are known to cause rapid gains in body fat. With creatine, that increase in fat was attenuated.

Creatine monohydrate enhances strength and body composition in Duchenne muscular dystrophy. Tarnopolsky MA et al. Neurology 2004 May 25; 62(10): 1771-7

Creatine monohydrate attenuates body fat accumulation in children with acute lymphoblastic leukemia during maintenance chemotherapy. Bourgeois JM et al. Pediatric Blood Cancer 2008 August; 51(2): 183-7

### **Does creatine improve performance in healthy young athletes?**

In a study of 16 elite male swimmers in their middle teens, half were given a loading dose of creatine (5 grams, 4 times a day for 5 days) or a placebo. It did indeed improve strength and performance in kids who were already in peak shape and highly trained for their sport.

Creatine supplementation improves the anaerobic performance of elite junior fin swimmers. Juhász I et al. Acta Physiol Hung. 2009 Sep; 96(3): 325-36

## Conclusion

It's pretty simple:

- Creatine is safe
- Creatine works

Proven benefits include:

- Increased lean body mass
- Increased muscle fiber cross-sectional area (muscle density)
- Fat loss
- Improved hydration
- Improved performance in strength, power, speed, and endurance
- Improved exercise response in the heat
- Improved functional capacity in patients with various neuromuscular diseases
- Better cognitive capacity
- Alleviated brain injury secondary to acute trauma
- Improved cognitive and motor function in infants with inborn errors of creatine metabolism
- Better outcomes for patients with COPD (chronic obstructive pulmonary disease)

In addition, creatine can offer a mild antioxidant effect in vitro, and has a positive effect on mood state and task completion after 24 hours without sleep.

But it doesn't ...

- Cause cramping or heat stress
- Cause oblique muscle strains
- Impair kidney function

For best results ...

- Take 3-6 grams of creatine monohydrate daily for maintenance
- If you choose to load for the fastest possible benefits, take 10 to 20 grams daily for a period of 7 to 14 days
- Weight-class athletes should stop creatine use at least 6 weeks before their next weigh-in

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**WRITTEN BY NICK TUMMINELLO**  
NICKTUMMINELLO.COM

**EDITED BY LOU SCHULER**  
LOUSCHULER.COM

Once again, I want to thank my friends who shared their expertise and research with me. Please visit their websites:

Jose Antonio: [www.joseantoniodphd.com](http://www.joseantoniodphd.com)

Brad Schoenfeld: <http://workout911.com/?p=2948>

Alan Aragon: <http://alanaragon.com/>

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