

Issue 175 In a nutshell

There is good evidence that creatine supplements increase muscle strength for short duration, maximum intensity exercise, such as required by weight lifters, some footballers and sprinters. It can also increase lean mass.

Recent trials have increased our understanding of the appropriate dose and timing in relation to exercise.

Creatine as a sports supplement

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NUTRITION RESEARCH REVIEW

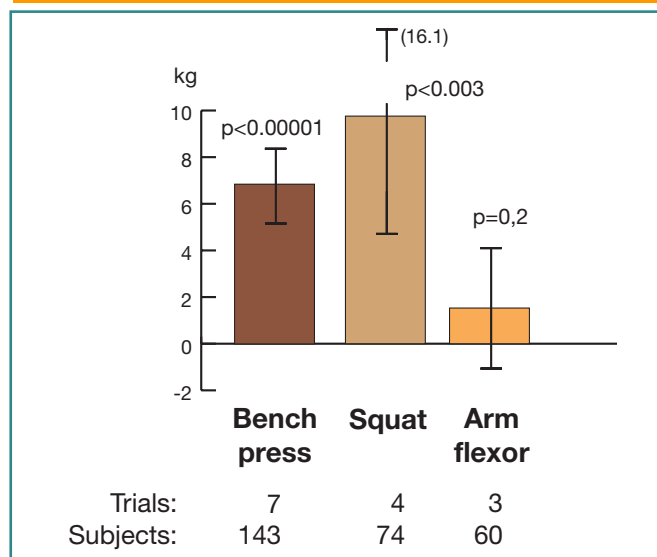
Study 1: Creatine and muscle strength

Creatine supplementation when combined with resistance training improves strength in young men, according to a new meta-analysis of controlled trials.

Subjects/method: A meta-analysis combining data from 16 studies published between 1996 and 2000. These trials involved 20 discrete samples totalling 414 subjects, most of whom were young men.

Results: There was a significant improvement in strength on creatine supplementation - see Graph. (Although increase in arm flexor strength is shown as being not statistically significant, it was modestly significant in the only trial which did not involve subjects over 60 years of age).

Graph (Study 1): Weighted mean differences in strength: creatine vs placebo



Ref.: Dempsey RL, et al. Does oral creatine supplementation improve strength? A meta-analysis. *J Fam Pract.* 2002;51(11):945-51.

Table 1 (Study 2): Effect size of supplementation: creatine vs placebo

	Effect size*	Signif.
Regimen		
Loading	0.26	p=0.0003
Loading + maintenance	0.04	
Type of repetition		
Multiple	0.25	p=0.028
Single	0.18	
Location		
Upper body	0.42	p<0.0001
Lower body	0.21	
Total body	0.13	

* = difference in means/pooled SD

Study 2: A closer understanding of the impact

A different meta-analysis was able to narrow down the effects of creatine supplementation on body composition, performance and in relation to the way that the supplement was given.

Subjects/method: Meta-analysis of 100 randomised, placebo-controlled, double-blinded trials (RCTs).

Results: There were small but statistically significant improvements in body composition (especially lean body mass), exercise duration and intensity.

The effect was greater following short-term supplementation, for repetitive and laboratory-based rather than 'in the field' exercise (and for upper body resistance exercise of short duration (e.g. isometric, isokinetic, and isotonic). See Table 1 (above).

Ref.: Branch JD. Effect of creatine supplementation on body composition and performance: a meta-analysis. *Int J Sport Nutr Exerc Metab.* 2003;13(2):198-226.

Comments

Several months ago (in issue #166) we concluded that certain amino acids supplements might be useful in building muscle mass in the elderly, provided resistance exercise was also undertaken.

One such amino acid is creatine, found in meat and fish (as well as being synthesised from other amino acids). Creatine is also relevant in sports nutrition.

This is because muscles undertaking maximal exertion of short duration (<30 seconds) require energy derived from ATP regenerated by the anaerobic metabolism of phosphocreatine (along with glycogen)¹. Indeed, there is evidence that fatigue in such exercise is related more to low phosphocreatine than high lactate levels².

This applies particularly to sports requiring single or repeated short duration bursts of muscle activity, such as power lifting or the short sprints characteristic of football. Creatine supplementation has already become popular amongst such athletes. Happily, the science in this case is also quite encouraging.

Quite a lot of research on creatine supplementation in sports medicine has been published over the last ten years. Whilst not all trials agree, overall there seems little doubt that creatine supplements can reduce fatigue and enhance performance during short duration, high intensity exercise, both one-off and or intermittent. It also seems to increase lean body mass when used in conjunction with resistance exercise.

The new meta-analyses include many of the clinical trials that support these conclusions. And there are more of them. These two meta-analyses included trials published up to the year 2000. The editorial team here at Arbor has identified a further 27 clinical trials published since that time, 21 of which had positive results - see Table 2.

The reason why creatine increases body weight is probably because of water retention initially. But when resistance training is undertaken 'swollen muscle' is likely to result in a real growth in lean muscle mass^{1,3}.

The meta-analysis in Study 2 contributes to our understanding of the best way to take creatine supplements. Doses of around 15-30 gm/day (~20x typical dietary intake) over 4-6 days prior to exercise seem to offer the best results. Higher or longer term

Application	Positive results
Lean mass	4/5 trials
Muscle performance	16/22 trials
Other (mental fatigue x2, muscle injury x1)	3/3 trials

Table 2: Creatine trials published in 2001-2003¹¹

maintenance dosage is not likely much to add to the impact^{1,3,4}.

Two other ways have been suggested to maximise effectiveness: combining creatine supplements with exercise (to increase muscle utilisation) and consuming it with carbohydrate (to raise absorption)¹.

The impact is also greater when initial creatine levels are low¹. For example, a recent study found these supplements increased lean mass and muscle strength more in vegetarians than non-vegetarians (who had higher initial muscle creatine levels)⁵.

Regarding safety, the most prudent conclusion is that we do not yet know enough to be sure about safety of long term administration or at very high doses. Evidence so far has been reassuring, and does not confirm anecdotal reports of minor side-effects^{1,3,5-9}, nor theoretical concerns that excess creatine (which is excreted as creatinine) might impair renal function¹⁰.

- References: 1. Casey A. et al. Does dietary creatine supplementation play a role in skeletal muscle metabolism and performance? *Am J Clin Nutr.* 2000 Aug;72(2 Suppl):607S-17S.
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4. Lemon PW. Dietary creatine supplementation and exercise performance: why inconsistent results? *Can J Appl Physiol.* 2002 Dec;27(6):663-81.
5. Burke DG. et al. Effect of Creatine and Weight Training on Muscle Creatine and Performance in Vegetarians. *Med Sci Sports Exerc.* 2003 Nov;35(11):1946-1955.
6. Poortmans JR. et al. Adverse effects of creatine supplementation: fact or fiction? *Sports Med.* 2000 Sep;30(3):155-70.
7. Watsford ML. et al. Creatine supplementation and its effect on musculotendinous stiffness and performance. *J Strength Cond Res.* 2003 Feb;17(1):26-33.
8. Greenwood M. et al. Creatine supplementation during college football training does not increase the incidence of cramping or injury. *Mol Cell Biochem.* 2003 Feb;244(1-2):83-8.
9. Kreider RB. et al. Long-term creatine supplementation does not significantly affect clinical markers of health in athletes. *Mol Cell Biochem.* 2003 Feb;244(1-2):95-104.
10. Robinson TM. et al. Dietary creatine supplementation does not affect some haematological indices, or indices of muscle damage and hepatic and renal function. *Br J Sports Med.* 2000 Aug;34(4):284-8.
11. For full list of these trials, see www.arborcom.com/updates/175/refs.htm

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