

Creatine common nutritional ergogenic aid biology essay

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Introduction (Page 2-3) Review (Page 3-8) Conclusions/Future Directions (Page 8-9) References & Bibliography (Page 10-12)

Creatine: A Common Nutritional Ergogenic Aid and its Effects on Performance in Sports.

Introduction

Ergogenic Aids (and Performance-Enhancing Drugs) are not original concepts when it comes to improving sporting performance. The term 'ergogenic' derives from the Greek word 'ergon', which means 'work', and 'genic' meaning 'producing' (Harris & Harris, 1998). Both Novice and Professional Athletes have been using them for hundreds of years with a 'win at all cost' attitude. According to Schroder et al., (2002), almost 60% of elite athletes (in all sports) claim to use at least one dietary supplement, with different aids being used for different sports. These supplements are proposed to improve performance, prevent/treat injury and disease. A number of these supplements are available as 'over the counter' products and are completely legal while others are artificial and illegal - often banned by several sporting organisations. WADA (World Anti-Doping Agency) was established in 1999 to try and decrease the number of athletes taking banned substances within sport, with a motto of 'Play True'. Every year, WADA publishes a renewed list of banned/prohibited substances within sport. Ingredients relating to food that claim to improve an athletes' ability to perform physical activity are known as nutritional ergogenic aids (Williams, 1965) and are specifically used for their physiological effects by increasing performance, endurance and/or preventing injuries (Lawrence & Kirby, 2002). The FDA (The Food and Drug Administration) defines a nutritional

supplement that is legal as something that is proposed to supplement the diet by increasing the daily consumption rate or concentration rate. (FDA, 1995). Athletes who ingest nutritional ergogenic aids often consume amounts above the normal average (Maughan, 1999 and Benardot, 2006), with the timing of supplementation consumption in relation to training and competition being considered. Consumption of any medication, ergogenic aid or performance enhancing drug has some trepidations when it comes to their diversity. Many ergogenic aids are highly promoted and portray performance advertising claims, in order to increase sales. In some cases, the aid may exceed reality and in fact have no effect on an athletes' sporting performance. Creatine (Creatine Monohydrate) is probably the most popular nutritional ergogenic aid in this moment in time (Bemben & Lamont, 2005). It has been used since the early 20th Century as an ergogenic aid and was classified as a sports performance-enhancing drug in 1992, however, it is deemed legal (Bamberger, 1998). As with any ergogenic aid, motivation and psychological factors may increase as a result of expected or perceived benefits, causing increased effort without the supplement actually enhancing performance (placebo effect).

Review

Creatine is a mixture of three amino acids (glycine, arginine and methionine) and is located in the skeletal muscle, liver, pancreas and kidneys (Brunzel, 2003). Creatine is mainly found within the skeletal muscle and consists of 2 forms: 'Free' (which comprises for approximately 40%) and 'Phosphorylated' (which comprises for approximately 60%) (Greenhaff et

al., 1995). It is a vital component of the body's ATP-PC (Phosphagen) energy system, providing an anaerobic source (McArdle, Katch & Katch, 1999). The ATP-PC system occurs during short, high intensity activities that last between 5-10 seconds long, such as a 60-100 metre sprint, a Shot Put throw or weight lifting. During these activities, ATP (Adenosine Triphosphate) within the muscle must always be present. However, a great deal of it is used and ADP (Adenosine Diphosphate) is left over which is in effect, useless for exercise. Consequently, maximal-effort during exercise decreases. Because the activity only takes place over a short period of time, Phosphocreatine can restore the ATP that has been used. Therefore, with increased Phosphocreatine present, ATP can be restored in larger quantities at a more rapid rate. Creatine is already found within the average person's diet - mainly within exogenous sources such as meat. But in sport, it is known for being consumed as a supplement (Creatine Monohydrate). Davies (1965) and Harris, Söderlund & Hultman (1992) found that the Creatine Phosphagen system depletion during intense exercise is "commonly associated with the onset of fatigue." More recent research has shown that creatine supplementation (including tablets, powder, energy bars, and drinks) increases muscle strength, power and increases resistance to fatigue during brief, high intensity exercise (Gutfeld, 1997) and therefore does not benefit endurance athletes. However, the concentration in fast twitch (Type IIa and Type IIb) muscle fibres is superior but slow twitch fibres (Type I) have faster resynthesis proficiency due to their increased aerobic capacity (Casey, Constantin-Teodosiu, Howell, Hultman, & Greenhaff, 1996). A double-blind, placebo-controlled study devised by Kreider et al., (1998) examined creatine

supplementation over 28 days upon 25 Football players with their strength and body composition measured. Within this study, diet and exercise were closely controlled. Body weight, body mass and bench-press strength increased in the athletes who were taking creatine while the total lifting measurement increased by 41% within this group. In addition, a study by McGuine, Sullivan & Bernhardt (2001) regarding creatine supplementation in High School Football players, found that out of the 1, 349 players, 30% stated that they used creatine supplementation to enhance their sporting performance. This 30% completed a self-reported prevalence survey of creatine use, including perceived benefits and risks. Results showed that enhanced recovery after a high intensity workout was the most common perceived benefit of creatine supplementation. Grindstaff et al., (1997) supplemented 18 junior competitive swimmers' diets by increasing their creatine uptake to 21 grams a day. The 18 subjects were divided into two random groups - group 1 would take a form of creatine supplementation while group 2 would take a maltodextrin placebo. Both would take each supplement for 9 days during their training period. Grindstaff and associates measured repetitive sprint performances before and after three 100 metre freestyle sprint swims. Each swim had a 60 second recovery period afterwards. Subjects then performed three maximal-effort sprint tests on an arm ergometer for 20 seconds. The tests replicated the freestyle technique and again had a 60 second recovery period between tests. The results showed substantial differences in swim times in those consuming creatine supplementation than those who were not. Times were significantly faster in the creatine supplementation group. They also found that that overall time

to perform the three 100 metre swims was less in the group taking creatine supplementation. However, Mujika, Chatard, Lacoste, Barale & Geysant (1996) investigated the effects of creatine supplementation on sprint performance in twenty highly trained swimmers. Subjects were divided into a) a random creatine group (5 gram of creatine 4 times a day for 5 days) or b) a random placebo group (equal amount of lactose placebo). No noteworthy differences were observed in performance times between trials of different groups. With regards to the effects on sprint performance, Balsom, Söderlund, Sjödín, & Ekblom, (1995) investigated the effects of creatine supplementation (20 grams per day for 6 days) on phosphocreatine resynthesis when 5 x 6 second sprints were performed. Each sprint had 30 seconds recovery. The results discovered that creatine supplementation improved muscle phosphocreatine concentration after the 5th and final sprint. Another study tested the effect of creatine loading against a placebo group over 2 and 5 days upon anaerobic working capacity in women athletes. The results showed anaerobic work capacity to increase by 22% following the initial loading phase (Eckerson et al., 2004). As was said before, people can consume creatine in everyday food. Thus it cannot be considered illegal or harmful as it can be obtained in sufficient amounts naturally. However, the average consumption (of which is less than 2 grams) is an inadequate amount to have any affect whatsoever on sporting performance. Athletes often take creatine in phases, dependent upon training and competition. During the Loading Phase (which helps to saturate the muscles with creatine as best as possible), the normative, recommended amount of creatine to be consumed is 20-25 grams (5 gram increments) per day, for 4-

7 days. The total creatine content within the muscles increases by 10-25% if this particular loading is completed (Harris et al., 1992). Once the Loading Phase has ended, 2-5 grams of creatine are consumed per day in order to maintain a high creatine concentration within the muscles (Bemben & Lamont, 2005). Although there are some side effects when using creatine as a supplementation, they are extremely mild. Balsom, Söderlund, & Ekblom (1994) found that elite athletes, who consumed creatine dosages of 1.5 to 25 grams per day ranging from 1 week to a year, only experienced weight gain as a side effect. Weight gain is reported to be the most common side effect of creatine supplementation, due to water retention. This often makes the athletes feel sluggish and less motivated. Other side effects include dehydration, diarrhoea (gastrointestinal disturbances), nausea and muscle cramps (Leson, McGuigan & Bryson, 1988). However, there have been some issues and concerns raised in terms of kidney function when creatine has been used as a supplement. Poortmans & Francaux, (1999) state that the more creatine you consume, the more ends up in your urine - hence there is growing concern over kidney function/damage. As there is more creatine in your urine, the body has to make about 25% more each day. It has also been proposed that creatine supplementation could in fact overpower and destroy the body's own creatine synthesis. Vandenberghe et al., (1997) and Febbraio, Flanagan, Snow, Zhao, & Carey (1995) reported that it takes approximately 3-4 weeks for the muscle creatine and phosphocreatine contents to return back to their normal levels once creatine supplementation had stopped. However, following the 4 weeks, there is no evidence to suggest long-term suppression is present (Hultman, Soderlund, Timmons,

Cederblad & Greenhaff, 1996). Despite the negative claims of side effects, creatine is, when consumed in the recommended dosages, considered safe.

Conclusions/Future Directions

From these findings, short-term creatine supplementation is effective in increasing phosphocreatine concentration within the muscles, phosphocreatine resynthesis, as well as helping to maintain ATP concentrations during high intensity exercise. Creatine supplementation will also improve sprint performance, be it a single sprint or repetitive sprints, involving the ATP-PC (Phosphagen) energy system. However, individual responses to creatine supplementation may vary. The increase in muscle content of creatine depends upon the amount of creatine within the muscle before supplementation takes place. Athletes/people who have muscle creatine stores that are lower, for example vegetarians, who consume little or no creatine within their diet, may experience a greater increase in muscle creatine concentration by 20–40%, whereas those who already have high muscle stores, will increase stores by 10–20% (Kreider, 2007). Recent research has reported that creatine supplementation (5–7 grams) may be slightly more effective, with regards to the uptake of creatine into muscles, when combined with glucose (100 grams) (Green, Hultman, Macdonald, Sewell & Greenhaff, 1996a and Green, Simpson, Littlewood, Macdonald, & Greenhaff, 1996b). Other studies have also reported that adding β -alanine to creatine monohydrate could also produce greater effects. These include: increased strength, body mass, body fat percentage and also helping to delay the onset of neuromuscular fatigue (Hoffman et al., 2006). There has

been a great deal of controversy regarding creatine supplementation within sport, since research has reported that it can in fact improve sporting performance. Ingesting enough creatine from natural existing food sources to improve performance is somewhat difficult and therefore, whether creatine supplementation, a legal procedure, is ethical or not, is another matter.