LUCOZADE SPORT SCIENCE:
CREATINE USE IN SPORT

KEY POINTS

- Creatine is a nonessential dietary compound, synthesised primarily in the liver, from three amino acids: arginine, glycine and methionine.

- Creatine is most effective during sports or activities that involve repeated short bouts of high-intensity physical activity (up to 10 s), separated by short rest periods (30 s to 1 min).

- The most effective dose for individuals will vary, as the amount from supplementation that body can store will depend on individual muscle mass.

- It is recommended that individuals consume creatine in combination with carbohydrate as this seems to increase creatine accumulation in the muscle.

- To date, there appears to be no suitable evidence to support any adverse effects of creatine supplementation when consumed below or at the recommended dosages.

INTRODUCTION

Creatine is among the most widely used supplements known to improve athletic performance. It is a nonessential dietary compound, synthesised primarily in the liver, from three amino acids: arginine, glycine and methionine. The estimated daily requirement of creatine is ~ 2 grams (g), approximately 1 g of which comes from the diet (meats, fish and other animal products), whereas the rest is provided from sources within the body. Supplementation above this level, however, seems to increase power during anaerobic, short duration, high-intensity activities.

MECHANISMS OF ACTION

Energy Production

Within muscle, approximately two-thirds of the total creatine pool is found in the form of creatine phosphate (PCr). PCr functions to regenerate ATP, the immediate energy source for muscle contraction. The availability of PCr is thought to be a limiting factor in rate of ATP regeneration, therefore creatine supplementation may improve performance by increasing maximal energy production through an increased rate of ATP regeneration.

Muscle Buffering

A second suggested mechanism is that PCr may be involved in the buffering process within muscle. During high intensity exercise that places large demands on the glycolytic energy system - the system that provides energy without the presence of oxygen – there is an accumulation of lactate and hydrogen ions. The subsequent drop in pH (acidity) has been suggested to cause fatigue. Increasing the availability of creatine phosphate is thought to buffer the intracellular hydrogen ions, prolonging the point of fatigue.

In reality the performance benefits of creatine are a likely result of the interaction of a number of mechanisms. However, it is well established that a combination of these mechanisms appears to allow an athlete to perform a larger number of repetitive higher intensity bouts of training, leading to increased muscle mass and power, i.e. performance benefits are a result of creatine enhancing an athletes ability to train harder and/or for longer.

PHYSIOLOGICAL BENEFITS OF CREATINE

Supplementation with creatine can increase both the content of creatine and creatine phosphate within the muscle by ~ 20%. Consequently, creatine can increase an individual's ability to produce force ('strength'), regardless of sport, sex or age. Creatine is most effective during sports or activities that involve repeated short bouts of high-intensity physical activity (up to 10 s), separated by short rest periods (30 s to 1 min). This includes team, racket and power based sports that include the activities of sprinting, jumping, weight lifting and strength training. The performance benefits in these parameters may be explained by the slightly higher creatine levels observed in type II (glycolytic) muscle fibres associated with strength, when compared with the more aerobic type I muscle fibres.

PRACTICAL CONSIDERATIONS OF CREATINE INGESTION

Supplementation

Creatine is traditionally supplemented via a loading protocol, where up to 20 g per day during 5 days is consumed, followed by a maintenance phase of 3-5 g/day. More recently, creatine has been supplemented based on body mass with 0.07 g of creatine per kg body mass (g/kgBM) recommended. This recommendation is supported by the European Specialist Sports Nutrition Alliance (ESSNA), and is based on the fact that many different sports have varying typical body masses. Since around 95% of the body's creatine pool is found in muscles, the most effective dose for individuals will vary, as the amount from supplementation that body can store will mostly depend on individual muscle mass. It is important to note that ~ 25% of athletes already have saturated creatine stores and would therefore be non-responders, whilst those deficient in creatine due to poor dietary intake or low internal stores (vegetarians) may benefit significantly.

Creatine and carbohydrate

Consume creatine in combination with carbohydrate as this seems to increase creatine accumulation in the muscle. This occurs with the normal recommended intake of creatine and small amounts of carbohydrate (≥ 18 g); although in some cases much larger volumes of carbohydrate have been used (~ 100 g). However, take care to ensure that the carbohydrate consumed with creatine is factored into the overall daily requirement for carbohydrate in the diet.

Possible adverse effects

To date, there appears to be no suitable evidence to support any adverse effects of creatine supplementation when consumed below or at the recommended dosages. However, if you are pregnant or suffer from kidney disorders you should consult your doctor before taking creatine. Creatine has been linked with fluid retention and an increase in body mass (0.6 – 1.0 kg). As a result those athletes in weight classified sports should monitor this carefully during training.

Criteria for creatine ingestion

Creatine is not a short cut to athletic success. It is a nutritional supplement designed to help athletes cope with the demands of an intense training schedule, in a similar way as ingesting a high carbohydrate diet, sports drinks, and/or carbohydrate loading to optimise performance. The key criteria for using creatine include:

- The individual is past puberty and involved in sports that may benefit from creatine.
- The individual is eating a well-balanced, performance-enhancing diet
- The individual (& support team) approve the use of creatine
- Creatine supplementation is supervised by trainers, coaches and/or doctors
- The recommended dosages are not exceeded
- The supplement is tested by an independent laboratory to assure its quality.

RECOMMENDED READING

- Balsom, P. D., Soderlund, K., Ekblom, B. (1994). Creatine in humans with special reference to creatine supplementation. Sports Medicine, 18, 268-280.

- Bemben, M. G., Lamont, H. S. (2005). Creatine supplementation and exercise performance. Sports Medicine, 35, 107-125.