PERFORMANCE TRAINING SYSTEMS

SPORT-SPECIFIC CONDITIONING CONSULTANTS

'Sport-Specific Conditioning is our Focus, Performance is our Goal'

- PERFORMANCE NUTRITION - SPORT-SPECIFIC CONDITIONING - ATHLETE DEVELOPMENT- PERFORMANCE PSYCHOLOGY -

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Performance Training Systems Position Statement

Use of Creatine by Baseball Players

Creatine is a naturally occurring compound which can be absorbed directly from dietary sources such as meat and fish or endogenously synthesized from three amino acids; arginine, glycine and methionine. It is synthesized by the liver, kidney and pancreas and it is delivered into the muscle cell by active transport. Increases in dietary arginine, glycine and methionine do not increase creatine production, and production appears to be controlled by a feed-back loop determined by creatine blood levels. There is a 2 gm/day turnover rate of creatine in a 70Kgm person of which 50% is synthesized and 50% is obtained from dietary meat and fish to replace the loss. Ingestion of 20-30 mgs/day of exogenous creatine for a period of one week can increase human creatine from between 10 - 25% in those individuals who are either deficient in creatine or are capable of transporting high concentrations into the cell. Individuals who already have high levels of intramuscular creatine do not appear to demonstrate these dramatic increases in concentration. Approximately 70% of the population will increase cellular creatine with supplementation, while 30% will not. Cellular creatine is determined solely by the cells ability to actively transport creatine into the muscle as it is not manufactured in the muscle cell.

Creatine is found in both the free and phosphorylated form, and its dominant role is in the regulation and homeostasis of muscle energy metabolism. At rest, creatine is 60% in the form of phosphocreatine in a reversible equilibrium with creatine under the influence of creatine kinase. One third of supplementary creatine appears to be in the form of phosphocreatine. During the initial phases of exercise, particularly high intensity exercise, phosphocreatine, + ADH + H+ creates creatine and ATP. This provides an immediate energy source. Phosphocreatine is thus a reservoir for the production of ATP when this is required by the metabolic demand of the muscle cell. This reaction appears to occur maximally in type II muscle fibers. Creatine supplementation does not increase ATP in the muscle but rather phosphocreatine, the substrate for ATP production. This presence is essential for explosive high intensity exercise, providing energy prior to the cardiovascular/pulmonary response. Elevated levels of intracellular creatine may also increase the rate of phosphocreatine re-synthesis, allowing for a more rapid recovery time between bouts of exercise. Other effects of this potentially enhanced energy delivery and availability include potentially increased efficiency with a lower production of lactate, ammonia and hypoxanthine and a capacity to adapt to higher levels of training intensity. Phosphocreatine may also be an energy carrier, bringing energy from the mitochondria to different ATPase sites in the cytosol.

THE PHYSIOLOGICAL AFFECTS OF CREATINE

The potential for creatine to promote improved explosive, high intensity exercise is present on a metabolic basis. However at least 30% of the population will not increase cellular creatine significantly with exogenous supplementation. This raises the question of inadequate dietary intake or a metabolic variance in the 70% who are responders. Additionally, as creatine is absorbed by and not manufactured by the muscle cell, continued supplementation of 20 - 30 gms/day leads, by day 3, to 68% excretion of supplemental creatine in the urine. This implies that there is an upper limit on the amount of creatine that can be stored. The question of the efficacy of continued, long-term supplementation of high levels of creatine is then raised.

Muscle cross-sectional area has been demonstrated to increase with the use of creatine, much of which appears to be water. Recent evidence would suggest that actual protein synthesis may be stimulated by creatine with an increase of muscle protein, particularly type II fibers. Long term use may increase weight by 3-4 Kgm but comparison with dietary protein supplementation needs study.

Creatine is taken in different loading programs to increase intracellular concentration. A short-term program incorporates 20 gms of creatine daily in divided doses for a period of 5 - 7 days. This form of loading is designed for repetitive short-spurt activity. Longer term loading is variable but usually entails 20 gms of daily creatine for one week followed by 2 - 25 gms per day for a period of months. This program is alleged to increase sprint and repetitive activity to a greater degree and may also increase lean body mass. Creatine supplementation appears to be augmented by a high carbohydrate low-fat diet and regular training. Caffeine during the loading program appears to reduce the increase in muscular levels of creatine.

Creatine has been evaluated by many studies to determine its efficacy in improving performance in sports and conditioning activities. Sprint activities may improve by 1 - 5%, repeated sprints by up to 15%, one repetition maximum weight lifting by 5 - 10%, and one repetition vertical jump by 5 - 10%. Anaerobic/capacity recovery may improve and mitochondria may be stimulated. Specific sports activities have also shown various levels of improvement, though no studies specific for baseball have been performed. Alternatively, studies have demonstrated no improvement in performance, improvement limited to only a subset of the experimental population and changes of an insignificant magnitude. Long-term submaximal endurance events, and maximum oxygen consumption do not appear to demonstrate any significant improvement.

POTENTIAL ADVERSE EFFECTS

Adverse results from creatine use have been reported. Individuals appear to be at greater risk for muscle cramps in hot or humid weather as a result of fluid and electrolyte shifts into muscle, as well as obligatory water loss from excessive protein intake. Endogenous creatine production is suppressed by supplementation and is not immediately returned to normal. Susceptibility to heat stress, muscle strains and cardiac dysrhythmias remain concerns, but have not been definitively proven. Athletes are required to pay approximately thirty dollars for one kilogram of creatine and, as there is no governmental inspection, the purity of products have not been evaluated . The long-term effects of sustained creatine supplementation requires investigation as does the frequency and effect of excessive consumption.

The ethics of employing creatine as an ergogenic aid remains controversial. For many, creatine represents a natural product employed in a manner similar to glycogen loading. To others, creatine is being employed not as a natural dietary product but rather in amounts 10 and above times normal, solely for the purpose of enhancing performance. Natural products taken in an unnatural manner to act as an ergogenic aid requires ethical debate.

RECOMMENDATIONS

It is the recommendation of Performance Training Systems that:

1. Institutions should not endorse or supply creatine for their baseball players. The efficacy of the drug in baseball has not been established, and performance factors that have been evaluated demonstrate varied and often insignificant results. The potential adverse affects, both short and long-term require further study.

2. Medical personnel who advise baseball teams should be aware of: A. Medical recommendations B. Potential adverse results C. Preventive intervention for adverse results D. Updates on new research E. Changes in the status of the product in order to offer accurate up-to-date information to individual athletes independently requesting advise

3. The ethics and regulation of the use of creatine as an ergonenic aid in baseball requires further consideration. The lack of regulation and testing of nutritional supplements requires further governmental review.