

Concussion and Nutrition: The Potential of Creatine

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What is a concussion? Not too long ago, you were considered to have a concussion only if you lost consciousness from a head injury. In fact, not only do you not have to lose consciousness (research suggests only 10% of people do),¹ but you don't even have to hit your head. Many of the concussions in military personnel have occurred from the force of an explosion, not from a direct blow to the head. We also know that many concussions happen during whiplash injuries, like a car accident or in an infant that is violently shaken. Concussions are the most common type of traumatic brain injury and are often referred to as mTBI. Although the vast majority of research pertaining to nutrition and concussions has been done on animals, the potential for creatine and other nutrients to aid in the treatment and prevention of concussions is mounting.

mTBI's have a primary and secondary component.² The primary component is the immediate damage the brain sustains from the trauma. This includes bruising of the brain and some possible bleeding, shearing and tearing of nerves, other brain cells and blood vessels. A substantial amount of nerve cell death begins within hours of the primary injury. The secondary injury component starts within minutes of the trauma and may go on for years. This secondary component involves chemical reactions and abnormal brain cell functioning and this is where creatine and other nutritional approaches work.

What is actually happening in the brain during this prolonged secondary component of mTBI is damage to the actual nerve cells, particularly the membrane of the cells. A damaged membrane causes the mineral ions of calcium, sodium and potassium to become imbalanced inside and outside the cells causing the cells to swell leading to brain dysfunction and even more nerve cell death. Since 40% of the energy the brain uses is to maintain the balance of these mineral ions a major energy crisis begins as the brain struggles to maintain balance. The brain also starts having trouble using glucose or blood sugar as an energy source causing an even greater energy crisis.^{3,4,5}

Other than the building energy crisis, the four major problems of the secondary component in the brain are: Excitotoxicity, Oxidative stress, Mitochondrial dysfunction and Inflammation. All of these processes lead to even more of an energy crisis due to their destructive effects on cell membranes and mitochondria.

Creatine is a compound made up of three amino acids found in large amounts in muscle tissue, traditionally used by body builders to increase muscle mass, but it is also found in high levels in the brain involved in energy production. Creatine combines with phosphate ions to form a

storage molecule called creatine phosphate. This molecule is an energy buffer for muscles⁶ and for the brain in which the level of creatine phosphate is even higher than the level of ATP.⁷ In the central nervous system, creatine operates by donating a phosphoryl group to ADP to make ATP thereby helping to replenish energy stores.⁸ It has been shown with proton magnetic resonance spectroscopy that creatine levels in the brain decrease after sustaining a concussion.⁹ It has also been shown that taking creatine-monohydrate orally is able to cause a significant increase of brain creatine levels.¹⁰

There have been two human-based randomized prospective studies with positive results on children and adolescents specifically related to its effects in moderate and severe traumatic brain injury. In this research, improvements in cognition and behavior were seen in children and adolescents. This evidence comes from long-term studies in which treatment with creatine was started soon after injury. Creatine's effects may have influenced brain function during both the early phase of injury as well as in later stages. Creatine is thought to maintain the function of the mitochondria (energy producing part of the cell) and improve blood flow in the brain, both of which are disrupted during the acute phase of concussion. These studies have suggested that post-concussion creatine improves both short and long-term symptoms. In the short term, post TBI creatine supplementation has been shown to reduce the duration of post concussion amnesia. Subsequently, those treated with creatine had significantly better cognitive abilities,¹¹ less headaches, dizziness and fatigue,¹² than those that were untreated after three and six months of follow up. The dose in one of the studies was .4g's per kg. This converts for those in the U.S. to 1.8g's of creatine for every 10 lbs. So for a 100lb child this would be a dose of 18g's per day. This is actually a higher dosage than the typical load-

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ing dosage for body builders, which is usually .3g's per kg of body weight.

It appears from studies with vegan and vegetarian adults that cerebral creatine concentrations can be optimized by the use of oral supplementation of only 5 gm per day and has been reported to be beneficial in improving memory.¹³

Creatine, which is found in protein rich foods, such as meat, fish and poultry is a very common athletic supplement, but in the case of concussion, creatine appears to be able to be a significant weapon to help combat the massive energy crisis that occurs in mTBI and help the brain heal. As with numerous other nutritional supplements from alpha-lipoic-acid to DHA specific concussion related research in humans need to be done. It is my opinion that multi pronged nutritional protocols should be researched along with mono therapies since the metabolic cascade involves numerous pathophysiological components from inflammation to oxidative stress and glutamate toxicity to mitochondrial dysfunction.

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