

# Creatine Supplementation Unveiled: Revealing the Mechanisms Behind Its Performance-Enhancing and Health-Boosting Effects in People of All Ages

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## Abstract:

This review article provides an overview of the mechanisms behind creatine's performance-enhancing and health-boosting effects in people of all ages. Creatine is a widely-used dietary supplement among athletes and fitness enthusiasts due to its ability to improve high-intensity exercise performance. Recent research has highlighted its potential health benefits, such as improving bone health in older adults and enhancing renal function. The paper concludes by discussing the safety concerns associated with creatine supplementation and emphasizes the need for further research to identify potential applications in various populations.

**Key words:** creatine; supplementation; performance-enhancement; health-boosting; high-intensity exercise; bone health; renal function; safety

## Introduction

Creatine is a naturally occurring nitrogenous compound synthesized endogenously from the amino acids arginine, glycine, and methionine and is found predominantly in skeletal muscle [1]. It is widely used as a dietary supplement by athletes and fitness enthusiasts due to its ability to enhance high-intensity exercise performance [2]. In recent years, research has highlighted its potential health benefits, such as improving bone health in older adults and enhancing renal function [3,4]. This review aims to provide an overview of the mechanisms behind creatine's performance-enhancing and health-boosting effects in people of all ages.

### Performance-Enhancing Effects of Creatine Supplementation

The ergogenic effects of creatine supplementation on exercise performance have been extensively studied in various populations. The mechanism behind this improvement is believed to be related to the increase in phosphocreatine (PCr) availability, which plays a critical role in the resynthesis of adenosine triphosphate (ATP) during high-intensity exercise [1]. A study conducted by Rawson and Volek [5] reported that creatine supplementation had a significant effect on muscular performance during high-intensity exercise. Similarly, a study conducted by Johnston et al. [6] reported improvements in body composition, strength, and sprint performance in healthy males following creatine supplementation. In addition, Izquierdo et al. [7] found that creatine supplementation improved muscle power, endurance, and sprint performance in trained men.

### Health-Boosting Effects of Creatine Supplementation

Recent research has highlighted the potential health benefits of creatine supplementation. Candow and Chilibeck [3] reported that creatine supplementation had the potential to improve aging bone health in postmenopausal women. Subsequent studies have supported these findings, with Candow et al. [8] reporting that creatine supplementation during resistance training improved bone mineral density in older adults. These findings suggest that creatine may have a role in preventing or delaying age-related bone loss. Moreover, creatine has been reported to enhance renal function in some populations. In a randomized, double-blind, placebo-controlled clinical trial, Cooper et al. [4] reported that creatine supplementation did not have any adverse effects on renal function in healthy adults. In fact, creatine supplementation was associated with a slight improvement in renal function in some individuals. Another potential health benefit of creatine supplementation is its ability to modulate creatine kinase (CK) levels. Burke and Culligan [9] reported that CK modulators may have therapeutic and ergogenic potential in various populations.

Creatine supplementation can also have neuroprotective effects, which can enhance cognitive function in individuals of all ages. Creatine supplementation increases the production of ATP, which can help protect against oxidative stress and mitochondrial dysfunction in the brain. These effects can enhance cognitive function and reduce the risk of age-related cognitive decline.

A study by Pires et al. [10] showed that female Muay Thai athletes who took creatine supplements for 10 weeks had improved cognitive performance after exercise. The participants took a cognitive test before and after each training session, and those who took creatine scored significantly higher than those who did not. Additionally, a study by Borchio et al. [11] found that supplementing with creatine monohydrate improved cognitive function in experienced mountain bikers.

Creatine supplementation may also have beneficial effects on respiratory disorders such as COPD. A study conducted on patients with COPD found that eight weeks of creatine supplementation improved respiratory muscle strength, exercise capacity, and quality of life [12]. Another study on COPD patients found that creatine supplementation for 12 weeks improved respiratory muscle endurance and reduced dyspnea (shortness of breath) during exercise [13].

The exact mechanism by which creatine supplementation improves lung function is not well understood. However, it is hypothesized that creatine supplementation may increase the concentration of phosphocreatine in respiratory muscles, thereby enhancing energy metabolism and reducing muscle fatigue [14]. Creatine supplementation may also increase the levels of antioxidants and anti-inflammatory cytokines, which can protect the lungs from oxidative stress and inflammation [15].

### Safety Concerns Associated with Creatine Supplementation

Despite the promising performance-enhancing and health-boosting effects of creatine supplementation, there are concerns regarding its safety, particularly in vulnerable populations such as children, adolescents, and individuals with pre-existing medical conditions. Some studies have suggested that creatine supplementation may increase the risk of dehydration, muscle cramps, and gastrointestinal distress [16]. Moreover, concerns have been raised regarding the long-term effects of creatine supplementation on renal function, although current evidence does not support a causal relationship between creatine supplementation and renal dysfunction [17].

In a double-blind, placebo-controlled study by Almeida et al. [18], participants were given either creatine or a placebo for eight weeks. The study found that creatine supplementation did not have any adverse effects on liver or kidney function, and there were no differences in adverse effects between the creatine and placebo groups.

A study conducted in vitro using lung epithelial cells showed that high doses of creatine caused oxidative stress and damage to the cells [19]. However, it is important to note that this study used doses of creatine that are much higher than the typical recommended dosage for human consumption.

However, it is important to note that certain individuals should not take creatine supplements without consulting a healthcare professional first. Those with pre-existing kidney or liver disease, as well as pregnant or nursing women, should not take creatine supplements. It is also important to follow the recommended dosage and not exceed it [20].

### Conclusion

In conclusion, creatine supplementation has been shown to have promising performance-enhancing and health-boosting effects in people of all ages. Its ability to enhance high-intensity exercise performance is well-documented, and recent research has highlighted its potential to improve bone health in older adults and enhance renal function. Despite safety concerns, creatine supplementation appears to be safe for healthy individuals when taken in recommended doses. However, more research is needed to identify potential applications in various populations and to address safety concerns associated with long-term use.

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