Proceedings of the 2nd International Conference on Modern Medicine and Global Health
DOI: 10.54254/2753-8818/8/20240461

The effect of creatine on human body

Jingpeng Ai

Shekou international school, Shenzhen, 518000, China

lshhs112007@ldy.edu.rs

Abstract. The impact of creatine on the human body used as supplementation is explored in this research paper, delving into the analysis of the effects of supplementing with creatine on the human body. A naturally occurring amino acid, creatine can be obtained from our diet and is primarily stored in muscle tissues, acting as an essential source of energy metabolism. For ages, athletes have used creatine as a dietary supplement to enhance muscle strength and size, sporting performance, and cognitive functionality, given its critical role in human body. The focal point of this article is the effect that creatine supplementation has on muscle development, cognitive abilities, aging musculoskeletal health, type 2 diabetes, and oxidative stress, as well as the potential negative outcomes. Based on the data, adding creatine to a routine can have advantageous impact on muscle growth, mental function, oxidant pressure, type 2 diabetes, and the effects of aging on bone and joint health. Although creatine supplementation is commonly deemed as safe, it is crucial to exercise caution when consuming large quantities or using it for an extended period, particularly in individuals with pre-existing health conditions. The study concludes that incorporating creatine supplementation into one's routine may prove beneficial for those seeking to enhance their athletic abilities, muscle mass, strength, and overall well-being. Nevertheless, to fully understand, research is required the potential advantages and risks related to creatine supplementation. Furthermore, it is imperative to ascertain the ideal dosages and protocols that would be suitable for diverse populations and varying conditions.

Keywords: Creatine, Cognitive Function, Type 2 Diabetes, Oxidative Stress.

1. Introduction

Creatine, a nitrogenous organic acid, undergoes synthesis in the pancreatic, liver, and kidneys by utilizing arginine, glycine, and methionine the three amino acids. It is mainly stored within the skeletal muscle tissue, fulfilling a vital function in generating ATP, the primary source of energy employed by the body during intense physical exertion. The arrangement of elements in creatine is composed of a guanidine group that contains nitrogen, which is linked to a carboxylic acid group. Additionally, there is a nitrogen atom that has a methyl group attached to it. This exclusive arrangement enables creatine to promptly contribute a phosphate group to ADP, thus renewing ATP when there is a surge in energy requirements.

Many research studies have evaluate the impact of adding creatine to improve physical performance, promote muscle development, and enhance general well-being. These investigations have revealed that taking creatine as a supplement can lead to an increase in both muscle size and power, boost anaerobic capacity, and prolong endurance. Furthermore, the use of creatine has demonstrated promising potential

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for enhancing cognitive function, mitigating the effects of type 2 diabetes, promoting healthy aging of the musculoskeletal system, and reducing oxidative stress.

The articles objectives is to evaluate the existing academic sources on the effect of creatine on the human anatomy, specifically concentrating on the enhancement of muscles and possible adverse outcomes. Through a thorough analysis of the obtainable data, this paper aim to present a holistic comprehension of the plausible advantages and hazards linked to the usage of supplemental creatine.

2. Creatine's impact on muscle growth

Several studies have studies impacts of creatine supplement on muscle strength, and growth in individuals who participate in resistance training. Willoughby and Rosene in 2001 carried out a 12-week study with inexperienced males, where participants were randomly assigned to control, placebo, or creatine (Cr) groups. The creatine group consumed 6 grams of creatine daily for 12 weeks and demonstrated noteworthy enhancements in overall body mass, fat-free mass, thigh capacity, muscle power, and myofibrillar protein compared to the controlled group. Muscle samples revealed that the creatine group experienced more significant growth in myosin heavy chain (MHC) mRNA expression for various muscle types compared to the control and placebo treatment groups. The researchers suggested that the increased MHC synthesis might be accountable for the observed enhancements in muscle dimensions and power [1].

Rawson and Volek investgated an study in 2003 it executed a thorough examination of 22 investigations to explore the impacts of creatine addition on training execution, especially in weightlifting and muscle power. The analysis disclosed that participants who ingested creatine during resistance training displayed roughly 8-20% greater muscle power execution compared to those who consumed a placebo treatment. Weightlifting execution was also significantly higher in the creatine group, with an approximate increase of 14-26% compared to the placebo group. When focusing on the bench press exercise, the creatine group demonstrated a considerable increase in the range of one-repetition maximum (1RM) and weightlifting execution [2]. These findings suggest that creatine addition can considerably enhance muscle power and weightlifting execution during training.

In another study by Kerksick, the impacts of combining D-pinitol with creatine monohydrate were investigated in resistance-trained individuals. Participants were allocated to either a Creatine + Pinitol (CRP) group or a Creatine Monohydrate (CR) group. Both groups followed a loading phase of 20 g/d for 5 days, followed by 5 g/d for the remaining 23 days, and underwent resistance training for 4 weeks. The outcomes demonstrated that both groups experienced increased creatine retention, enhanced power, and improved body composition. However, the CR group showcased lean mass and fat-free mass increased by substantial amounts compared to the CRP group. The study concluded that the addition of D-pinitol to creatine did not provide extra advantages for physiological adaptations during resistance training, while intake of creatine monohydrate supplements alone was effective in improving power and body composition [3].

Overall, these studies collectively suggest that creatine supplementation, particularly with creatine monohydrate, can lead to significant improvements in muscle strength, size, and training adaptations in resistance-trained individuals. The addition of D-pinitol to creatine does not appear to provide extra benefits in terms of physiological adaptations.

3. Creatine's effect on liver and kidney functions

Persky and Brazeau executed a study to investigate the impacts of high-dose creatine supplements for liver function in healthy adults. The study focused on the clinical pharmacology and therapeutic application of creatine supplementation. It emphasized that creatine, when consumed as a dietary supplement, has the potential to enhance exercise performance and increase fat-free mass. The study discussed the advantages of creatine supplementation, such as preventing ATP depletion, promoting protein synthesis, reducing protein breakdown, and fortifying cell membranes [4]. The findings from studies on physical activity indicated favourable outcomes, including improved muscular strength and power, diminished tiredness during exercise, and augmented muscle size.

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In a research in 1999 by Juhn, university athletes who consumed creatine supplements for up to 12 weeks exhibited no substantial alterations in kidney or liver function in comparison to a controlled group. The aim of the research was to evaluate the possible damage caused by taking additional creatine to the liver and kidneys. The trial comprised of 50 university athletes and integrated a placebo group to decrease prejudice. The findings exhibited that kidney and liver function in athletes who consumed creatine supplements were comparable to those who did not consume creatine, suggesting that creatine supplementation does not lead to immediate damage to these organs [5].

Kreider performed a study to assess the safety and efficacy of creatine supplementation in resistance-trained men in 2017. The study discovered no significant alterations in liver function in participants who consumed creatine supplements for 12 weeks. The investigation consistently demonstrated that creatine supplementation enhances intramuscular protein concentrations, leading to enhancements in high-intensity exercise performance and training adaptation. The study also emphasized the potential advantages of creatine supplementation in the recovery after exercise, injury prevention, and thermoregulation, rehabilitation, and neuroprotection. The authors concluded that creatine supplementation is safe and effective when used within recommended doses, with a suggested intake of up to 30 grams per day for five years and 3 grams per day for a lifetime [6].

Overall, these investigations suggest that creatine addition, even at elevated amounts, does not seem to have noteworthy harmful impacts on liver or kidney operation in fit individuals. Moreover, creatine addition is deemed secure and efficient when utilized according to suggested principles and holds the capability to offer numerous advantages for sportspeople, such as enhanced workout accomplishment, prevention of injuries, and aid in rehabilitation.

4. Creatine's impact on cognitive functions

Multiple research studies have analyzed the impacts of creatine on cognitive performance in various groups. Rae executed an examination on fit youthful grown-ups and discovered that creatine addition had a significant constructive outcome on working memory and intelligence, underscoring the significance of brain energy potential in affecting cognitive performance [7]. Likewise, McMorris in 2007 explored the influences of creatine addition on cognitive performance in elder people. Their examination uncovered remarkable positive impacts on cognitive functioning, aside from reverse number recall [8]. These discoveries propose that creatine addition provides cognitive advantages for elder individuals.

Additionally, Avgerinos investigated the impacts of rapid the effects of resistance training on mental and physical performance in elderly individuals with cognitive weakness. Their research showcased that the exercise treatment notably enhanced cognitive function, physical capabilities, and muscular power, underscoring the possibility of exercise interventions to augment cognitive performance in this particular group [9].

Furthermore, Yoon conducted a study on healthy older adults and found that creatine supplementation led to improvements in cognitive tasks related to attention and mental fatigue. This study further supports the potential cognitive benefits of creatine supplementation in the aging population [10].

Overall, these investigations collectively offer proof that creatine supplementation and workout interventions can yield favorable impacts on cognitive performance in various groups. These discoveries imply the possibility of employing creatine and physical activity as approaches to improve cognitive abilities in both youthful and elderly individuals.

5. Creatine and Type 2 diabetes

Two investigations have explored the impacts of creatine addition on glucose regulation in people with type 2 diabetes. Sawyer et al. (2019) executed a 12-week experiment to assess the consequences of resistance workout and creatine addition on glucose regulation and muscle potency. Their discoveries indicated that the blend of creatine addition and workout training resulted in a noteworthy decrease in glycosylated hemoglobin (HbA1c) levels in contrast to the control group. Additionally, creatine addition

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led to enhanced glucose regulation and amplified enlistment of glucose transporter type 4 (GLUT-4) to the muscle cell membrane [11].

Likewise, Gualano (2011) examined the impacts of creatine supplementation on type 2 diabetics' glucose tolerance and insulin sensitivity. Their 12-week experiment also displayed noteworthy enhancements in glycemic regulation, as demonstrated by reduced HbA1c levels, decreased glucose concentration, and enhanced glycemia during a meal tolerance assessment. The research underscored that creatine supplementation, in conjunction with exercise training, amplified glycemic regulation and elevated GLUT-4 translocation [12].

In general, these investigations offer proof that creatine supplementation, when combined with exercise training, can provide advantages for glycemic control in individuals with type 2 diabetes. Both investigations showed notable decreases in HbA1c levels and enhancements in glucose control, indicating the possibility of creatine supplementation as an additional treatment for managing glycemic control in individuals with type 2 diabetes.

6. Creatine and Oxidative stress

Creatine supplementation has been examined for its potential antioxidant properties in several studies. Arazi (2021) presents evidence suggesting that creatine supplementation may have antioxidant effects. Oxidative stress is the outcome of an imbalance between the generation of reactive oxygen species (ROS) and antioxidant mechanisms, is linked with rigorous exercise or exercise at high dosages. Arazi emphasizes that creatine supplementation can positively impact the antioxidant system by increasing the activity of antioxidant enzymes and eliminating Reactive nitrogen species (RNS) and ROS. Creatine's antioxidant properties could ascribed to factors such as heightened cell energy status and preservation of mitochondrial integrity. However, the intensity and duration of training are crucial factors influencing the antioxidant activity [13].

Additionally, Simioni (2018) propose that creatine supplementation may have a role in diminishing oxidative stress and safeguarding against cellular damage. Routine exercise is recognized to possess various health advantages but can also trigger oxidative stress and inflammation. To tackle this, scientists have examined the potential of organic antioxidants, such as creatine, to counteract exercise-induced oxidative stress and inflammation. Simioni et al.'s analysis focuses on organic antioxidants like quercetin, resveratrol, curcumin, and highlights their characteristics and advantages in connection to physical activity and the aging progression. This implies that combining organic antioxidants, including creatine, with routine exercise holds potential in delivering positive effects on physical activity and the aging progression [14].

Collectively, these investigations propose that creatine supplementation might possess antioxidant characteristics and conceivably alleviate the oxidative strain provoked by physical exertion. Through boosting the antioxidant mechanism and diminishing the build-up of reactive oxygen species and reactive nitrogen species, creatine supplementation exhibits potential in safeguarding against cellular harm and encouraging beneficial outcomes on bodily movement and the aging process. Additional exploration is necessary to comprehensively grasp the mechanisms and optimum approaches for employing creatine as an antioxidant add-on alongside exercise.

7. Discussion

The exploration on creatine supplementation has shown its possible advantages on various facets of human health and performance, including muscle growth, brain function, type 2 diabetes, aging musculoskeletal health, and oxidative stress. However, as with any supplementation, it is important to assess the pros and cons. One notable benefit of creatine supplementation is its effectiveness in enhancing physical performance and muscle growth. Creatine has been demonstrated to increase muscle mass, strength, and power, and is commonly used as a dietary supplement by athletes and bodybuilders. Moreover, creatine has been discovered to enhance healthy people's cognitive functioning and may have potential as a cognitive booster. Another potential benefit of creatine supplementation is its effects on markers of aging and musculoskeletal health. Studies have discovered that creatine supplementation

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may help counteract age-related declines in muscle mass and strength, and may improve bone health. However, there are also potential drawbacks to consider. High doses of creatine may result in gastrointestinal distress, muscle cramping, and dehydration, and long-term use may pose risks to kidney and liver function. Additionally, the effects of creatine supplementation can vary depending on individual factors such as genetics and diet, and optimal dosages and protocols have yet to be fully determined.

Prospective investigation in this zone should aspire to further illuminate the optimum dosages and protocols for creatine enhancement and to fully comprehend its consequences on diverse populations and circumstances. For instance, exploration could scrutinize the repercussions of creatine supplementation in elderly individuals with sarcopenia or other age-related ailments, or in individuals with particular medical conditions such as Alzheimer's disease or multiple sclerosis. Moreover, forthcoming exploration could scrutinize the potential advantages of amalgamating creatine with other supplements or interventions, such as resistance training or cognitive training, to further amplify its consequences. This might be exceptionally pertinent in populations such as elderly individuals or individuals with particular medical conditions who may gain from multimodal interventions.

In general, the investigation on creatine supplementation has shown its potential advantages on various aspects of human health and performance. While caution should be exercised with elevated doses and extended usage, creatine supplementation may be a helpful tool for individuals seeking to enhance their athletic performance, muscle size and strength, and overall well-being. As with any supplementation, it is crucial to consider the pros and cons and to consult with a healthcare professional before initiating creatine supplementation. Future research should strive to further clarify the optimal amounts and protocols for creatine supplementation and to fully comprehend its effects on different populations and conditions, in order to unlock its complete potential.

8. Conclusion

In summary, creatine addition has shown encouraging promise in improving different facets of human well-being and achievement, comprising muscle expansion, cognitive ability, type 2 diabetes, aging bone and muscle health, and oxidative tension. Nevertheless, it is crucial to mention that the impacts of creatine addition can differ based on various factors, such as amount, length, and personal variability. Although creatine is generally deemed secure, its utilization at elevated quantities over extended durations might present dangers, particularly for individuals with pre-existing medical circumstances.

Despite the requirement for additional investigation, the accessible confirmation proposes that creatine supplementation can be a valuable instrument for individuals seeking to enhance their athletic performance, muscle size and strength, and overall well-being. With careful consideration of dosage and duration, creatine supplementation may offer a secure and efficient means of enhancing physical and cognitive capabilities. As such, it is an area worthy of continued examination, as we seek to further unlock the potential of this versatile and intriguing substance.

References

[1] Willoughby, D. S., & Rosene, J. M. 2001 Sci. Sports. Exerc. 10:1674-81.
[2] Rawson, E. S., & Volek, J. S. 2003 Strength. Cond. Res. 4:822-31.
[3] Kerksick, C. M., Wilborn, C., Campbell, W. I., Harvey, T., Marcello, B., Roberts, M. D., Parker, A., Byars, A., Greenwood, L., Almada, A. L., Kreider, R. B., & Greenwood, M. 2009 Strength. Cond. Res. 9:2673-82.
[4] Persky, A. M., & Brazeau, G. A. 2001. Pharmacol. Rev. 2:161-76.
[5] Juhn, M. S. 1999. Phys Sportsmed. 5:47-89.
[6] Kreider, R. B., Kalman, D., Antonio, J., Ziegenfuss, T. N., Wildman, R., Collins, R., Candow, D. G., Kleiner, S. M., Almada, A. L., & Lopez, H. L. 2017. Int. Soc. Sports. Nutr. 14:18.
[7] Rae, C., Digney, A., McEwan, S. R., & Bates, T. C. 2003. P. Roy. Soc. B-Biol. SCI.270
[8] McMorris, T., Mielcarz, G., Harris, R. C., Swain, J. P., & Howard, A. 2007.Aging NeuropsychoL C. 14 5, 517–528.

DOI: 10.54254/2753-8818/8/20240461

[9] Avgerinos, K. I., Spyrou, N., Βουγιούκας, K., & Kapogiannis, D. 2018. Exp Gerontol, 108, 166–173.
[10] Yoon, D. H., Lee, J. Y., & Song, W. (2018). J. Nutr. Health. Aging. 944-951.
[11] Sawyer, B. J., Bhammar, D. M., Angadi, S. S., Ryan, D. M., Ryder, J. R., Sussman, E. J., Gaesser, G. A. (2019). J Geriatr Phys Ther 46 3:149-150
[12] Gualano, B.De Salles Painelli, V.Roschel, H.Artioli, G. G.Neves Jr, M.De Sá Pinto, A. L.Rossi Da Silva, M. E.Cunha, M. R.García Otaduy, M. C.Da Costa Leite, C.Ferreira, J. C.Pereira, R. M. Chakur Brum, P.Bonfá, E.Lancha Jr, A. H.2011. Med. Sci. Sport.s Exerc. 43 5:770-8.
[13] Arazi, H., Eghbali, E., & Suzuki, K. 2021. Nutrients 13 3: 869.
[14] Simioni, C., Zauli, G., Martelli, A. M., Vitale, M., Sacchetti, G., Gonelli, A., & Neri, L. M. 2018. Oncotarget 9 24: 17181–17198