NICOLAUS COPERNICUS UNIVERSITY IN TORUŃ

Journal of Education, Health and Sport. eISSN 2450-3118

Journal Home Page
https://apcz.umk.pl/JEHS/index

KALINOWSKA, Zuzanna, ALEKSANDROWICZ, Hanna, KRĘŻEL, Maciej, KRĘŻEL, Olga, RYBIŃSKA, Marcelina and SZAFRANIEC, Artur. Creatine supplementation and cognitive function across different populations: A narrative review. Journal of Education, Health and Sport. 2026;88:69419. eISSN 2391-8306.
https://doi.org/10.12775/JEHS.2026.88.69419

The journal has had 40 points in Minister of Science and Higher Education of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 05.01.2024 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical culture sciences (Field of medical and health sciences); Health Sciences (Field of medical and health sciences).
Punkty Ministerialne 40 punktów. Załącznik do komunikatu Ministra Nauki i Szkolnictwa Wyższego z dnia 05.01.2024 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przypisane dyscypliny naukowe: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 01.03.2026. Revised: 08.03.2026. Accepted: 08.03.2026. Published: 15.03.2026.

Creatine supplementation and cognitive function across different populations: A narrative review

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Abstract

Creatine is a naturally occurring compound in the body that plays a key role in cellular energy metabolism by participating in the renewal of adenosine triphosphate (ATP). Due to the importance of ATP for neuronal function, creatine supplementation has been the subject of research into its potential effects on cognitive function. The aim of this study was to analyze the available scientific data on the effects of oral creatine supplementation on overall cognitive performance, memory and attention in various populations.

Based on a review of selected studies, it was found that creatine supplementation might have a moderate, context-dependent effect on cognitive function. The most consistent results were observed in the elderly, especially in terms of memory. Beneficial effects were also noted in conditions of increased energy demand, such as sleep deprivation. In the population of young, healthy adults, the results remain inconclusive. In turn, in clinical studies on neurodegenerative diseases, despite promising theoretical foundations, no significant clinical benefits have been demonstrated.

The available data suggest that the effect of creatine on cognitive function may be most pronounced in situations of reduced energy availability. Further high-quality, objective clinical studies are needed to determine the optimal doses, supplementation duration, and potential therapeutic indications.

Key words

Creatine, creatine supplementation, cognitive function, mental fatigue, brain energy metabolism, memory, neurodegenerative disease, amyotrophic lateral sclerosis, Parkinson’s disease, Huntington’s disease

The aim of the work:

The aim of this article was to analyze the relationship between creatine supplementation and cognitive functions, memory, and concentration in various social groups, based on available scientific publications.

Materials and Methods:

The article presents a narrative review of selected scientific studies on creatine supplementation and its effect on different populations. The objective of the work was to analyze any premises for creatine's positive impact on cognitive functions and memory in different populations such as the elderly, who have them naturally impaired but also in healthy adults. For this purpose, selected articles were analyzed using the PubMed, Web of Science and Google Scholar databases. The search strategy included the following key terms and their combinations: "creatine supplementation", "cognitive functions", "memory", "brain metabolism", "neurodegenerative disease", "amyotrophic lateral sclerosis", "Parkinson's disease", "Huntington's disease". The bibliographies of the cited works were reviewed to verify the references. Publications only written in English were considered. The bibliography search and article selection took place in February 2026.

Introduction

Creatine is a naturally occurring chemical compound that contains amino acids such as glycine, arginine, and methionine. (Avgerinos et al., 2018, Andres., et al. 2008, Chang and Leem, 2023) It is transported to tissues by the SLC6A8 carrier protein (Wyss and Kaddurah-Daouk, 2000), while neurons themselves are capable of synthesizing it. (Braissant et al., 2002). With the help of creatine kinase, creatine is converted into phosphocreatine, which is a reversible reaction, while the breakdown product of creatine/phosphocreatine is creatinine, which is constantly produced in the body and removed by the kidneys. (Avgerinos et al., 2018, Deldicque et al., 2008) The most desirable function of creatine is the rapid delivery of energy, which occurs as a result of the transfer of a phosphate group from phosphocreatine (PCr) to adenosine diphosphate (ADP), which causes rapid renewal of the adenosine triphosphate (ATP) molecule at a time of increased metabolism and greater demand for this compound. (Roschel et al., 2021) It has also been suggested that creatine may act as an antioxidant, reducing the production of free radicals, which has an additional positive effect on tissues characterized by high metabolism and may have a significant impact on the course of neurodegenerative diseases. (Roschel et al., 2021, Beal et al., 2011) This could also be indicated by the fact that genetic syndromes associated with reduced endogenous creatine concentration are characterized by mental retardation, intellectual developmental delay, or autism. (Gualano et al., 2010, Roschel et al., 2021)

The effect of creatine supplementation on cognitive function in seniors

Systematic studies indicate a possible positive effect of creatine supplementation on memory improvement in older adults, while the effect on other cognitive functions remains unclear. (Marshall et al., 2026) Given the role of creatine in ATP resynthesis, it has been suggested that it may support cognitive processes with high metabolic demands, including memory. (Candow et al., 2025). McMorris et al. decided to investigate the effect of oral creatine monohydrate supplementation on cognitive function in a group of seniors. The study group consisted of 32 healthy seniors with an average age of approximately 76 years. They were divided into two groups: The first group received a placebo for one week, followed by creatine (5 g four times a day) for another week. The second group received a placebo throughout the study period. This regimen made it possible to limit the placebo effect and control for confounding variables. Before and after the study, the researchers conducted tests to assess executive function, number memory, spatial memory, and long-term memory. The results show that the group taking creatine performed better in the long-term memory category during recognition tests, and progress was also noted in numerical memory. However, it appears that creatine had no effect on recalling numbers “backwards” and generating random numbers. The conclusions drawn from this study suggest that creatine supplementation may have a positive effect on tasks requiring rapid access to memory. In more complex tests, where no improvement was observed, this may suggest that the supplementation period was too short. (McMorris et al., 2007)

Marshall et al. conducted an analysis of available studies on the supportive effect of creatine on cognitive function in seniors, and as many as 5 out of 6 studies showed a positive effect – the greatest benefits were again noted in the areas of memory, but seniors with an increased supply of creatine in their diet also performed better on tasks requiring more accurate, selective attention. However, they emphasize that despite the promising results, different studies used different doses of creatine and different durations of supplementation, which also complicates and prevents clear conclusions from being drawn. Therefore, high-quality, objective clinical studies are necessary to fully confirm the effect of supplementation with this compound. (Marshall et al., 2026) Data analysis conducted by Ostojic et al. showed a link between a creatine-rich diet and improved cognitive function in people over 60, which may highlight the importance of creatine not only as a supplement but also as part of the diet. (Ostojic et al., 2021)

The effect of creatine supplementation in healthy adults

Studies show that creatine may have a beneficial effect on cognitive function, especially memory, in adults. (Xu et al., 2024) Watanabe et al. conducted a study to examine the effect of creatine supplementation on performance during prolonged mental effort. The study involved 24 participants (19 men and 5 women) with an average age of approximately 24 years. A double-blind, placebo-controlled trial was used. The study group took 8 g of creatine monohydrate daily for 5 days. Participants performed the Uchida-Kraepelin Test (UKT), which involves continuously adding numbers for two 15-minute blocks with a 5-minute break. This test is a recognized tool for measuring mental fatigue. Spectroscopy was used to monitor the degree of hemoglobin oxidation in the left prefrontal cortex during the tasks. The key finding is that the group taking creatine monohydrate showed significantly lower levels of mental fatigue, and the decline in performance after completing the tasks was significantly lower than in the group taking the placebo. In turn, spectroscopy results indicated that creatine leads to increased oxygen utilization by the brain during mental work. This study suggests that oral creatine supplementation during periods of increased energy demand, such as high mental workload, may support cognitive function. Although the results are promising, researchers continue to emphasize that validation of this process is necessary. (Watanabe et al., 2002, Xu et al., 2024)

Rawson et al. decided to conduct a study to examine the effects of creatine supplementation in 22 young, healthy individuals. The study lasted 6 weeks and was conducted using a double-blind, placebo-controlled method. The average dose was 2.2 grams per day. The analysis of the study did not show any statistically significant changes. Creatine supplementation had no effect on memory or logic tests. The researchers hypothesized that creatine may only have a positive effect when cognitive functions are impaired for some reason, and that in an optimal state, the additional energy supply will have no effect. In addition, the blood-brain barrier may be a limitation, reducing the availability of the compound to the brain. (Rawson et al., 2008)

An analysis of 16 randomized trials conducted by Xu et al. showed a negligible effect of creatine supplementation on overall cognitive function in a group of 492 people aged 21 to 76. According to this study, creatine also had no effect on performance test results or the time taken to complete them. Detailed subgroup analyses indicated that in healthy adults, creatine had no significant effect on attention span. It is worth noting that, according to the study by Xu et al., women benefited more from creatine supplementation, as it significantly reduced information processing time compared to men. In addition, the most noticeable effect of creatine was observed on memory processes. (Xu et al., 2024)

The effect of creatine supplementation during extreme physical exertion

Sleep deprivation is a fairly common problem nowadays, which reduces attention levels and can also impair cognitive functions. (Kim et al., 2001) In one study by McMorris et al., researchers hypothesized that creatine supplementation would reduce performance decline in cognitive tests and improve mood when the body is under stress due to sleep deprivation. The study involved 19 people, divided into a creatine group (10 people) and a placebo group (9 people). The subjects took 20 grams of creatine monohydrate daily. The study was conducted using a double-blind method. What is striking about the results of the study is that the group taking creatine showed a significantly smaller decline in performance during RMG tests (ability to generate random sequences), and the creatine group also performed better in the balance test, making fewer posture corrections than the placebo group. In terms of mood improvement, the supplementation group reported significantly lower fatigue levels and greater vigor compared to the placebo group. However, no differences were found between the two groups in terms of short-term memory tests. The conclusion seems to be that creatine is particularly effective in tasks involving the prefrontal cortex, which is most sensitive to sleep deprivation. This would mean that creatine supplementation could be very useful for groups exposed to periodic sleep deprivation combined with physical exertion, such as medical personnel. (McMorris et al., 2006)

In another study, McMorris et al. investigated whether creatine monohydrate supplementation would have a positive effect during 36 hours of sleep deprivation, alleviating the effects of sleep deprivation. The researchers concluded that sleep deprivation increases the brain's demand for ATP, and the physical stress associated with it will exacerbate the deficit. The participants were 20 men aged around 21 who were sports students. The study group took 20 g of creatine monohydrate per day (4 x 5 g) for 7 days before the test; the control group received a placebo. Creatine supplementation was effective only in complex central executive system tasks, but did not provide any benefits in simple tasks – it did not affect short-term memory. It is suggested that creatine supplementation is effective only for highly complex tasks that strongly engage the prefrontal cortex and hippocampus (Frith et al., 1991, McMorris et al. 2007).

While previous studies suggested that the positive effects of creatine supplementation are the result of prolonged administration, at least one week (Dechant et al., 1999, Pan and Takahashi, 2007), Gordji-Nejad et al. hypothesized that a high, “rescue” dose of creatine at a time of high energy demand by the brain would be effective. They subjected 15 people to 21 hours of sleep deprivation and divided them into two groups: a placebo group and a group to receive 0.35 g/kg body weight of creatine monohydrate. Magnetic resonance spectroscopy was used for the measurements. In the placebo group, sleep deprivation led to a decrease in pH in the brain, while creatine supplementation prevented acidification. Creatine significantly improved information processing speed and short-term memory test scores compared to the placebo group. In addition, participants receiving creatine reported feeling less tired. (Gordji-Nejad et al., 2024)

The effect of creatine supplementation in patients suffering from neurodegenerative diseases

Huntington's disease is a genetically determined disorder characterized by, among other things, chorea, progressive dementia, and personality changes. Its biochemical essence is neuronal cytotoxicity caused by excess glutamate, as well as impaired energy metabolism in the brain.

(Taylor-Robinson et al., 1996, Bender et al., 2004) Due to the buffering function of creatine and its potential neuroprotective effect in animal studies (Matthews et al., 1998) Bender et al. decided to conduct a study in which they assessed the effect of creatine supplementation on metabolite levels in the brains of patients with Huntington's disease. Magnetic resonance spectroscopy methods were used for the assessment. Twenty subjects with symptomatic disease (mean age 46 years) supplemented creatine for 8-10 weeks. The results show a statistically significant decrease in glutamate and glutamine levels, but no clinical effect was observed when assessing patients on the MMSE scale, which the authors attribute to the short duration of the study. Bender et al. concluded that creatine supports the energy-consuming glutamate-glutamine cycle, which is impaired in Huntington's disease, and may also have a neuroprotective effect by stabilizing mitochondrial membrane potential and optimizing oxidative phosphorylation.

Kieburtz et al. on the other hand, set out to determine whether creatine supplementation is effective in slowing the clinical deterioration of Parkinson's disease patients, based on the premise of impaired mitochondrial energy metabolism. The study involved 1,741 participants (men and women) with early-stage Parkinson's disease who were already receiving dopaminergic therapy. The subjects were divided into two groups: placebo and 10 grams of creatine per day. Unfortunately, the study was terminated prematurely - the analysis showed that there was no chance of proving the benefits of supplementation during the study. The median observation period was 4 years. No statistically significant differences in clinical outcomes were found between the creatine group and the placebo group. The data obtained by the researchers do not support the use of creatine as a disease-modifying agent in Parkinson's disease. (Kieburtz et al., 2015)

Amyotrophic lateral sclerosis (ALS) is a disease with complex pathogenesis, associated with energy metabolism disorders and mitochondrial dysfunction. (Hervias et al., 2006) Rosenfeld et al. attempted to determine the effect of creatine monohydrate supplementation on the progression of ALS. The study was conducted as a double-blind trial, with a creatine dose of 5 grams per day and observations conducted over 9 months. Unfortunately, in this case, supplementation did not result in a statistically significant improvement in the clinical condition of the subjects in terms of motor function and functional capacity. The authors emphasize that the lack of clinical effects may be due to an insufficient dose and the heterogeneity of the disease. (Rosenfeld et al., 2008)

Discussion

The results obtained by researchers regarding the impact of creatine supplementation on cognitive function remain inconsistent. The most positive effect seems to be observed in seniors and in groups of people with increased energy requirements, while no benefits have been observed in neurodegenerative diseases. This may be due to the direct mechanism of action of creatine, which works mainly in circumstances of reduced ATP levels, which would be associated with the effects obtained during sleep deprivation. In the case of neurodegenerative diseases, the pathomechanism is much more complex, so simply increasing energy support may not be sufficient. The limitations of the studies cited may be the small size of the study group, as well as the variety of creatine doses selected at different durations of supplementation. Creatine could be considered a useful dietary supplement in older populations and in situations of maximum physical exertion, but this still requires long-term, objective studies with dose optimization.

Summary

An analysis of available studies indicates that creatine supplementation may have a moderate effect on cognitive function, particularly memory. The most promising effects were observed in older people and in conditions of increased metabolic stress, such as sleep deprivation. In healthy individuals, the results are inconsistent and do not allow for clear conclusions to be drawn.

Despite strong biological evidence, clinical trials in neurodegenerative diseases have not confirmed a significant therapeutic effect. This suggests that energy metabolism support alone may be insufficient in complex neurodegenerative processes.

Creatine remains a compound with a well-known mechanism of action and supportive use, but its role in improving cognitive function requires further long-term and standardized research.

Disclosure

Author's contribution:

Conceptualization: Z.K., H.A., O.K., M.K., M.R., A.S.; methodology: Z.K., H.A., O.K., M.K., M.R., A.S.; software: Z.K., H.A., O.K., M.K., M.R., A.S.; validation: Z.K., H.A., O.K., M.K., M.R., A.S.; formal analysis: Z.K., H.A., O.K., M.K., M.R., A.S.; investigation: Z.K., H.A., O.K., M.K., M.R., A.S.; resources: Z.K., H.A., O.K., M.K., M.R., A.S.; data curation: Z.K., H.A., O.K., M.K., M.R., A.S.; writing—original draft preparation: Z.K., H.A., O.K., M.K., M.R., A.S.; writing—review and editing: Z.K., H.A., O.K., M.K., M.R., A.S.; visualization: Z.K., H.A., O.K., M.K., M.R., A.S.; supervision: Z.K.; project administration: Z.K., H.A., O.K., M.K., M.R., A.S.

All authors have read and agreed to the published version of the manuscript.

Funding Statement: This Research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The authors confirm that the data supporting the findings of this study are available within the article's bibliography.

Conflicts of Interests: The authors declare no conflict of interest.

Declaration of the Use of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the authors used Gemini by Google for the purpose of refining the academic English language of the manuscript in order to maintain consistency and adherence to scientific writing standards in order to provide proper English grammar, style and clarity in the results. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the substantive content of the publication.

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