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Creatine supplementation and muscle performance: What are the effects of creatine supplementation on strength and endurance during strength training sessions?

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SUMMARY

Creatine is a widely used supplement in sports due to its ability to increase muscle phosphocreatine stores and thus contribute to the rapid resynthesis of ATP, especially during high-intensity, short-duration exercise. This study aimed to analyze the effects of creatine supplementation on maximal strength and muscular endurance in physically active young individuals.

This integrative literature review was conducted between March and April 2025, searching the US National Library of Medicine (PubMed), Scientific Electronic Library Online (SciELO), and Latin American and Caribbean Literature on Health Sciences (LILACS). Primary articles published between 2019 and 2025 addressing interventions involving creatine supplementation and its effects on muscle performance were included. The analysis considered methodological criteria such as study design, sample size, variables analyzed, and statistical significance of the results.

The results indicated that creatine supplementation, when combined with resistance training, promoted significant improvements in maximal muscle strength, as evidenced by increases in one-repetition maximum (1RM) tests. However, the findings on muscular endurance were inconsistent, with some studies demonstrating benefits and others finding no statistically significant differences. Furthermore, none of the studies analyzed reported serious adverse effects, confirming the safety of creatine when used within the recommended dosage. It is concluded that creatine is effective and safe for improving muscular strength, representing a valid ergogenic strategy for active young individuals, although its effects on muscular endurance still require further investigation.

Keywords: Keywords: creatine, supplementation, muscular strength, muscular endurance, resistance training.

ABSTRACT

Creatine is a supplement widely used in the sports world due to its ability to increase muscle phosphocreatine stocks and thus contribute to the rapid resynthesis of ATP, especially during high-intensity and short-term exercises. This article aimed to analyze the effects of creatine supplementation on maximum strength and muscle endurance in physically active young people. The results indicated that creatine supplementation, when associated with resistance training, promoted significant improvements in maximum muscle strength, as evidenced by increases in tests of a maximum repetition (1RM). However, the findings on muscle resistance showed inconsistency, with some studies demonstrating benefits and others not identifying statistically significant differences. In addition, none of the analyzed studies reported serious adverse effects, confirming the safety of creatine when used within the recommendations. It is

concluded that creatine is effective and safe for the improvement of muscle strength, being a valid ergogenic strategy for active young people, although the effects on muscle resistance still require further investigations.
Keywords: Keywords: creatine, supplementation, muscular strength, muscular endurance, resistance training.

INTRODUCTION

Creatine is a nitrogenous compound synthesized endogenously from the amino acids arginine, glycine, and methionine. It can also be obtained through the consumption of foods such as red meat and seafood. Its main function is to act as an energy reserve, contributing to the resynthesis of ATP, especially during short-duration, high-intensity activities (Silva et al., 2020). Creatine supplementation is widely used by athletes and bodybuilders to improve physical performance and promote muscle hypertrophy (Souza et al., 2021). Several studies demonstrate that the combination of supplementation and strength training can result in significant gains in maximum strength and muscular endurance (Almeida et al., 2022; Lopes et al., 2023).

Recent research shows that creatine is among the most commonly consumed supplements by young athletes. According to Jovanov et al. (2019), 82.2% of European athletes aged 17 to 18 reported using supplements, with creatine being one of the most common. These data highlight its popularity as an ergogenic aid, although its use should be guided by healthcare professionals.

Although many studies report positive effects, there are divergent results regarding muscular endurance, with some studies finding no significant differences between experimental and control groups (Chilibeck et al., 2020). Therefore, it is important to more rigorously investigate the effects of creatine on muscular strength and endurance in physically active young individuals.

Therefore, this work is justified by the growing popularity of creatine supplementation among amateur and professional athletes, and the need for scientific support regarding its true efficacy and safety. Furthermore, understanding how creatine influences different components of muscle performance can contribute to more effective interventions in sports and clinical practice.

Therefore, the objective of this study was to analyze, through an integrative literature review, the effects of creatine supplementation on muscular strength and endurance in young and physically active adults undergoing resistance training.

METHODOLOGY

This research was constructed based on an integrative literature review, with the aim of aim to gather and critically analyze the main scientific findings related to effects of creatine supplementation on muscular strength and endurance in individuals undergoing strength training.

The search for studies was carried out between March and April 2025, using the US databases National Library of Medicine (PubMed), Scientific Electronic Library Online (SciELO) and Latin American and Caribbean Literature in Health Sciences (LILACS) and Journals CAPES. The descriptors used, in Portuguese and English, were: “creatine supplementation”, “muscular strength”, “muscular endurance”, “resistance training”, “creatine supplementation”, “muscle strength”, “muscular endurance” and “resistance training”. combination of terms was done using the Boolean operators AND and OR, according to PICO (Population, Intervention, Comparison, Outcome) strategy, directing the selection of studies relevant to the topic.

Primary articles published between 2019 and 2025 in Portuguese were included. English or Spanish, which addressed experimental interventions on supplementation of creatine and its effects on muscle performance. Studies with models were excluded animals, reviews, meta-analysis, duplicate publications and opinion articles without methodology clear scientific.

After reading the titles and abstracts, eligible articles were subjected to a reading complete and critical analysis, considering aspects such as: methodological design, sample size, type of intervention, duration of the protocol, variables analyzed and statistical significance of the results. The evidence obtained served as a basis for the construction of the introduction of this work, as well as for the contextualization of the theme and the justification for the research.

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Study Selection Process for the Integrative Review on Supplementation Creatine

The following flowchart presents the steps in the identification, screening, and eligibility process. and inclusion of the studies used in this integrative review. The search was carried out in four databases — US National Library of Medicine (PubMed), CAPES Journals,

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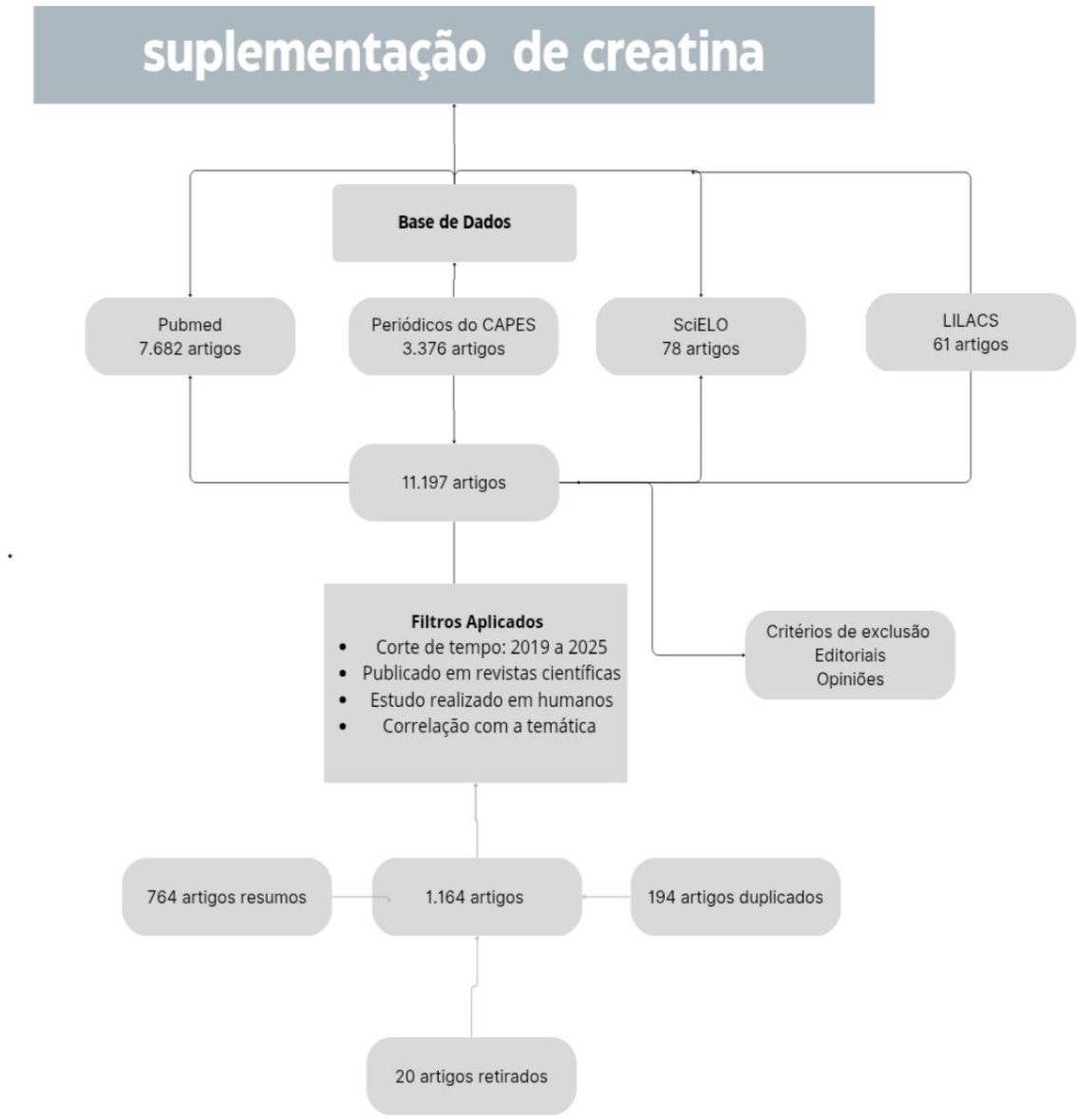
Scientific Electronic Library Online (SciELO) and Latin American and Caribbean Literature in Health Sciences (LILACS) — initially resulting in 11,197 articles. After application inclusion filters (time frame between 2019 and 2025, studies published in journals scientific, carried out with humans and correlated with the theme), as well as the criteria exclusion criteria (editorials and opinion articles), 20 articles were selected for final analysis. This process ensured greater methodological rigor and scientific relevance to the sample studied.



Source: developed by the authors, Thiffany Silva Piñon and Juliana Malinovski 2025.

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RESULTS

In table 1, described below, the most significant results were compiled from each scientific article selected in the research, as well as authors, type of study, year of

publication, population, supplementation protocol, results on muscular strength, result in muscular endurance and conclusions. The 7 articles are studies published in journals international, six held in Brazil and one held in Europe.

Table 1 – Summary of articles analyzed for review.

Article	Author, year of publication, place of study	Design, type of study and N	Study objectives	Main methodologies	Findings
1	Martins et al., 2023, Brazil	Randomized clinical trial, N = 30	To evaluate the effects of creatine supplementation on muscular strength and endurance in trained young individuals	Supplementation creatine (5 g/day) for 8 weeks. Evaluation of 1RM and muscular endurance tests	Creatine group showed higher increases in maximal strength and muscular endurance compared to placebo
2	Correa & Lopes, 2020, Brazil	Experimental study, N = 24	Investigate the effects of creatine on bodybuilders	Participants divided between creatine and placebo. Resistance training for 6 weeks	Creatine group showed significant improvements in strength and endurance in multi-joint exercises
3	Panta & Silva Son, 2016, Brazil	Systematic review, N = 16 studies	Evaluate the effectiveness of creatine on muscle performance	Review of experimental studies in humans, published between 2005 and 2015	Most studies have reported positive effects of creatine on muscular strength and endurance, and
4	Silva et al., 2024, Brazil	Double-blind, placebo-controlled study, N = 40	To evaluate the effects of creatine on muscular endurance in active men	Creatine (5 g/day) for 6 weeks, with assessment of the number of repetitions to failure	Supplementation increased the muscular endurance significantly nte in comparison to placebo
5	Jovanov et al., 2019, Europe	Cross-sectional observational study, N = 912	Investigate the use supplements among adolescent athletes	Application of a structured questionnaire to young athletes from 9 countries	Creatine was one one of the most consumed supplements,

					standing out by your association with strength gain
6	Oliveira and al.2022, Sao Paulo, Brazil	Randomized double-blind clinical trial N=28	To analyze the effects of creatine supplementation on strength and body composition in trained young individuals	Participants 28 men trained in bodybuilding, di seen in groups: Creatine and placebo. The intervention lasted six weeks with assessment of muscle strength by MRI and lean body mass by bioimpedance .	There was a significant increase in strength in exercises isolated and compounds (p<0.05) in the creatine group. lean muscle mass also increased significantly Ante. muscular endurance was maintained.
7	Rocha and al.,2020 Minas Gerais	Controlled clinical trial, N = 24	To investigate the impacts of creatine supplementation on strength and training volume for cross-training practitioners. in	A study involving 24 amateur athletes was divided into a placebo group and a creatine and group. The protocol lasted eight weeks, and maximum strength (MSTR), total training volume, and supplementation safety were evaluated.	group Creatine showed an increase significant strength (p<0.01) and total training volume.No humef relevant collateral effect was reported, confirmed made the the Supplement safe.

Source: Table developed by the author, 2025.

DISCUSSION

Martins et al. (2023), in a study of trained men, observed that creatine monohydrate supplementation, administered in a saturation protocol followed by maintenance, promoted significant gains in maximum strength, measured by the one-repetition maximum (1RM) test in the bench press and leg press. These results suggest that creatine may enhance the effects of strength training on neuromuscular performance.

Corroborating this evidence, Corrêa and Lopes (2020) also observed significant increases in strength in weightlifters after eight weeks of supplementation combined with resistance training. According to the authors, the main physiological mechanism involved is the increased availability of intramuscular phosphocreatine, facilitating the rapid resynthesis of ATP during high-intensity, short-duration efforts.

However, the effects of creatine on muscular endurance are still controversial in the literature. In their study, Martins et al. (2023) reported that, although maximal strength increased significantly, gains in muscular endurance (assessed by submaximal repetitions to fatigue) were not statistically significant. On the other hand, Silva et al.,
(2024), in a similar sample, reported improvements in both strength and muscular endurance, which may be related to the time of supplementation, the intensity of training and the training level of the participants.

The systematic review conducted by Panta and Silva Filho (2016) reinforces that the effectiveness of creatine supplementation depends on proper periodization and combination with well-structured training. Analysis of multiple clinical trials indicated that the most effective protocols include a saturation phase (20g/day for 5 to 7 days) followed by maintenance (3-5g/day), which favors intramuscular creatine accumulation and its ergogenic effects.

Another relevant aspect is the safety of creatine supplementation. None of the studies analyzed reported significant adverse effects when used within the recommended doses. According to Kreider et al. (2017), creatine is one of the most studied supplements and is considered safe when administered to healthy individuals, with no robust evidence of harm to kidney or liver function.

It's also important to highlight the popularity of creatine among young athletes. Jovanov et al. (2019) found that 82.2% of European athletes aged 17 to 18 used supplements, with creatine being one of the most consumed. This scenario reinforces the importance of professional guidance, as indiscriminate use may not be effective and, in some cases, generate unrealistic expectations.

In another study, Oliveira et al. (2022) observed significant improvements in strength performance in compound and isolated exercises after six weeks of supplementation in trained young individuals, with a notable increase in lean muscle mass. Although muscular endurance was not the primary focus, the authors reported maintenance of performance in submaximal sets.

Rocha et al. (2020) demonstrated that creatine supplementation promoted increased muscle strength and training volume in amateur cross-training athletes. Furthermore, the study reported no significant side effects, corroborating previous findings on the supplement's safety (Kreider et al., 2017).

Recently, a meta-analysis conducted by Desai et al. (2024) evaluated the effect of creatine supplementation in adults under 50 years of age, combined with resistance training. The results indicated a significant increase in lean mass (1.14 kg) and

reduction in body fat percentage (-0.88%), reinforcing the effectiveness of creatine in improving body composition in young populations.

Furthermore, Wang et al. (2024) conducted a systematic review and meta-analysis that demonstrated that creatine supplementation, combined with resistance training, promoted significant increases in upper and lower limb muscle strength in adults under 50 years of age. The study also suggested that the effects may be more pronounced in men than in women, indicating the need to consider factors such as sex and age when prescribing supplementation.

Regarding safety, Bonilla et al. (2021) analyzed the prevalence of side effects reported in clinical trials and concluded that creatine supplementation is safe for healthy individuals, with a low incidence of adverse effects. This conclusion is corroborated by other reviews that highlight the safety of creatine use in various populations.

Finally, recent studies have also explored the effects of creatine across different age groups and exercise types. For example, a systematic review by Forbes et al. (2021) indicated that creatine supplementation combined with resistance training may be effective in improving muscle strength in older adults, suggesting potential benefits across the lifespan.

CONCLUSION

This review demonstrated that creatine supplementation, when combined with strength training, has positive effects on maximal muscular strength and, in some cases, muscular endurance in physically active young individuals. These findings are consistent with several contemporary studies that have analyzed the ergogenic efficacy of creatine in different populations.

Based on the analysis of the seven studies reviewed, it is possible to conclude that creatine supplementation has consistent positive effects on increasing maximal muscular strength in physically active young individuals, especially when combined with resistance training. Most studies demonstrated significant gains in one-repetition maximum (1RM) tests, especially in compound exercises such as the bench press and leg press, indicating a substantial improvement in neuromuscular capacity in supplemented individuals.

Regarding muscular endurance, the results remain mixed. Although some studies report an increase in the ability to perform submaximal repetitions until fatigue, others found no statistically significant differences between the control and experimental groups. This discrepancy may be related to factors such as intervention time, dosage protocol, training intensity, and participants' fitness level. Therefore, this is a field that still requires more controlled and standardized studies to reach definitive conclusions.

Another relevant point is the safety of creatine supplementation. All studies included in the review reported good tolerance to the supplement and the absence of significant adverse effects when consumed within the recommended dosages. This evidence reinforces data from previous reviews that position creatine as one of the most studied and safe supplements available on the market, even with the support of international organizations such as the International Society of Sports Nutrition (ISSN).

Furthermore, the popularity of creatine use among young athletes reinforces the need for proper guidance from healthcare professionals. Indiscriminate use, without a prescription or supervision, can compromise the supplement's effectiveness and lead to unrealistic expectations about its effects.

Thus, it is concluded that creatine supplementation is an effective and safe strategy to enhance the effects of resistance training on muscular strength in physically active young individuals. However, its effectiveness on muscular endurance still requires further scientific investigation. It is recommended that creatine use be individualized, taking into account the practitioner's goals, their training routine, and the supervision of qualified health and physical education professionals.

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