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Creatine Supplementation: Resisted, Sprint and Jump Training Program

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Abstract

Great results regarding physical activity and performance (increasing muscular strength, power, and endurance) may be obtained through appropriate dietary diet, associated with the structure-training program. Creatine supplementation seems to promote increases in strength (relative and absolute) and muscular power, and its effects are more evident in predominantly anaerobic activities; however, some studies have demonstrated evidence in aerobic activities (increase in performance in intermittent aerobic activities and modifications in the use of energy substrates during movement). Physical Activities such as strength training (resistive exercises), jumps, and sprints appear to be significantly affected by creatine supplementation. Up to the present time, there is no evidence that creatine can cause health problems; therefore; people, who want to improve their athletic performance, might use creatine as a supplement.

Keywords: Creatine; Resisted training; Sprint training; Jump training program

Introduction

Needs for better results lead to athletes and physical activity practitioners to search for effective ways to optimize performance and body composition. Improvements in physical performance can be achieved through appropriate nutritional habits **[1]**, linked to the control of the intensities and rest periods of the exercises, obtained through the adequate control of the training methods **[2]**.

Regularly, performance standards are surpassed by better-prepared individuals and more specialized in the activities they practice, and possibly use some ergogenic resource to achieve their achievements. Any type of substance, process or procedure that may be capable of improving physical performance, including pharmacological agents, nutritional, physiological, psychological and mechanical components, which is considered an ergogenic resource [**1, 3]**.

One of the variables of the training that can cause significant impact on the desired results is the nutritional component. The elaboration of a diet containing adequate amounts of macronutrients (carbohydrates, proteins, and fats) and micronutrients (vitamins and minerals) is essential to obtain satisfactory results. However, deficiencies in the intake of certain nutrients are observed continuously, due to the high metabolic demand of the activity practiced.

In Brazil nowadays, there is extensive use of supplements, which are used both for ergogenic and aesthetic purposes **[4]**. One of the most prevalent compounds among athletes is creatine **[5]**, in its monohydrate form, and it is widely used and researched supplement in recent times **[6].** Creatine supplementation may be useful in maintaining high energy levels (ATP: adenosine triphosphate) during intense physical activities **[7]**, and is more efficient in exercises where the specificity of energy production depends on the ATP-PC system (phosphocreatine or algae anaerobic). Strength and muscular power work are benefited with creatine supplementation **[8]**. Likewise, short duration and high-intensity activities are susceptible to performance improvements **[5]**.

The way creatine is administered (ingested) can be performed from short-term (5-7 days) and long-term (> 15 days) protocols. Numerous studies have examined the effects of short periods of supplementation on the performance of physical activities **[5]**. The amount of creatine ingested during supplementation protocols ranges from 20-30g per day (or 0.3g / kg body weight/day), separated and consumed over 24 hours in portions of 5-7g, dissolved in some liquid for the better **[8-10]**.

There are different forms of creatine available for use in research studies or as nutritional supplements:

- Creatine monohydrate is the primary form used in the studies;
- Creatine phosphate is found in small amounts being extremely expensive, limiting its use;
- Creatine citrate can be found in dietary supplements, but not is applied in scientific studies;
- Micronized creatine has better intestinal absorption, dissolving in liquids **[11]**.

Any form of ingested creatine has the function of elevating the body's stores of free creatine and Phosphorylated Creatine (PC), and some of the effects observed after periods of creatine supplementation are:

- Increase in the maximum capacity to develop muscle strength **[12]**.
- Increased muscle performance during repetitive exercise series **[13, 14].**
- Reduction of the time of single sprints and consecutive sprints **[15]**.
- Improvement in muscle power levels **[16-18]**.
- Increase in total body weight **[14 19-21]**.
- Increased lean body mass and muscle mass **[22, 23]**.

Adverse reactions and side effects from acute (short-term) and chronic (long-term) intake of creatine remain unclear and controversial, and some authors report that short-term supplementation does not lead to any pathological problem **[24]**, however, the Brazilian Society of Sports Medicine, in a recent guideline, recommends the use of creatine only for competitive athletes engaged in activities.

Methods

The search was performed at the bases: Science Direct, MEDLINE (PubMed via), Scielo, Lilacs, and Scopus from August 2018 to Feb 2019. The following search strategy was used for each database. The search terms were: “creatine”, “resistant training”, “speed shots” and “heel training”. No search was done for unpublished works or annals of congresses.

Results

Creatine Supplementation and Resisted Training

Creatine supplementation, in conjunction with resistance training, promotes strength gains and muscle hypertrophy **[25]**. However, the mechanisms which creatine exerts an ergogenic effect on chronic adaptations to strength training still cause controversy, however, it is speculated that they may be due to gain in lean body mass (25), increased **[26; 23]**. In the present study, it was found that in the absence of a high level of myosin.

A nine-man study (age: 20.7±1.9yr., height: 179.3 ±4.7 cm, body mass: 88.5 ± 17.0 kg) was practiced for at least five years and supplemented (0.3 g / kg body weight of creatine in the first week and 0.05 g / kg body weight in the other three weeks) and undergo periodic muscle strength training (week 1: 3x10-12, week 2: 3x8 -10, week 3: 5x5, week 4: 5x3) containing exercises for large and small muscle groups.

After the experimental period of supplementation and training, significant increases ($p <0.05$) were observed in the total maximum load (1RM) in both the squatting (140kg for 146kg) and supine (113kg for 122kg), (1570W for 1670W) and ballistic bench press (730W for 800W) (using 30% of 1RM for squatting and bench press) [23].

Nine handball players (age: 20.8 ± 5yr, height: 182 ± 8cm, body mass: 79.4 ± 8kg) were supplemented for five days (20g creatine per day) and submitted to maximum repetition tests (RMs) and maximum load (RM). No significant changes ($p <0.05$) were observed in maximal strength (1RM) production during the bench press; however, the maximum number of repetitions using 60% of 1RM showed a significant increase ($p <0.05$) (16.1 ±2.9 rep to 18.8 ± 3.5 rep.). Likewise, the maximum number of repetitions using 70% of 1RM in the squatting medium underwent significant changes ($p <0.05$) (13.2 ±3.0 rep to 15.9 ±2, 1 rep), as well as in the (1RM), reverent at 133± 11.9 kg to 147.7± 14.1 kg ($p <0.01$) **[27]**.

Ten men (age: 24 ± 1 yr., height: 71 ± 1 cm, body mass: 74 ± 2kg), strength training practitioners with three sessions/ week frequency, were supplemented for four days with 20g of creatine and the subsequent 17 days with the 2g day. Three weeks of creatine supplementation were performed in conjunction with resistance training with exercises for large and small groups, with a training volume consisting of 3 sets of 8-10 repetitions, with rest periods ranging from 60-120s between sets. After the experimental period of supplementation and concomitant training, significant increases ($p <0.01$) were observed in a maximal dynamic contraction (1RM) in the supine rectum (87 ±4 to 91 ±3 kg) and in the leg press (280 ±19 to 313 ± 22 kg) **[28]**.

After 12 weeks of creatine supplementation (6g / day of creatine) in conjunction with high intensity strength training (conducted 3 times per week, containing training protocol equivalent to 3 sets of 6-8 repetitions, using 85-90% of 1RM, separated by rest periods of 90s between sets and between exercises), significant increases ($p < 0.05$) were observed in the relative strength (1RM (kg) / body weight (kg)) of the lower limbs (3. 23 to 4.98) of untrained men (age: 20.41 ± 1.73 years, height: 180.44 ± 3.72cm, body weight: 85.49 ± 14.28kg) analyzed from leg press exercises, extension of legs and flexion oflegs **[26].**

Male subjects, aged 24 ± 5, height: 179 ± 7, body mass: 84.1 ± 8.2 kg), healthy and trained, were submitted to a five-day supplementation protocol with a daily intake of 20 g / day. Before and after the supplementation period, an isometric test was performed on the supine rectum, consisting of five sets of the 20s of maximum contraction, separated by two-minute rest intervals between sets. A significant increase in the peak power and total strength produced during maximal isometric contractions of the creatine supplemented group (creatinine concentration ≥ 32 mmol/kg dry muscle) was observed.

As well as trained individuals, sedentary women may also benefit from creatine supplementation, being given a 20g / day creatine intake for four consecutive days, and staying for another ten weeks at doses of 5g / day.

Creatine Supplementation and Jump Training

Energy suppression for a jump or a small series of jumps, with or without overload, is mainly provided by high energy inorganic phosphates (ATP-PC). The literature shows that creatine supplementation may lead to performance improvements primarily in exercises with periods of less than the 30s (WILLIAMS & BRANCH, 1998), however, the performance of both vertical and horizontal jumps can be optimized with appropriate periods of ingestion of creatine.

Seven healthy physical activity men underwent creatine supplementation for seven days (25 g / day creatine), with significant improvements ($p < 0.05$) at the peak of force production (measured in Watts) during five series of ten repetitions) consecutive jumps using 30% 1RM in the squat [**29].**

Another study carried out, with nine men (age: 20.7± 1.9 yrs.; height: 179.3 ± 4.7 cm; body mass: 88.5 ± 17.0 kg) was practiced for at least five years, supplemented during four weeks (0.3 g / kg body weight of creatine in the first week and 0.05 g / kg body weight in the other three weeks) and undergo periodic muscle strength training, demonstrated significant increases in performance of heels with load (30% 1RM of the squat) after the experimental period [**23].**

Male athletes supplemented with 3 g / day of creatine for 14 days, engaged in out-of-season resistance training, achieved significant increases ($p < 0.05$) in the anaerobic vertical jump test, but 1RM on bench press, 40-yard leg extensions were not modified between periods before and after supplementation [**30].**

Nine male handball players underwent five days of creatine supplementation (20g / day), and two consecutive jumps analyzed the performance of jumps on a contact analysis platform, and the height of the jumps was computed at the total flight time. There was a significant ($p < 0.05$) increase in jump height (flight time, 31.4 ± 1 to 33.1 ± 1 cm) of the creatine-supplemented group, after performing a series of 10 repetitions in the middle squatting (70% of 1RM), data not corroborated with rested subjects or after the 1RM test in the middle squatting [**27].**

Due to increases in creatine phosphate stocks after supplementation, the possibility for improvements in single or consecutive jumps performance increases. Possibly due to higher amounts of ATP / sec given to the skeletal muscles, as well as the reduction of recovery time (an increase of ATP re synthesis), which may influence the consecutive execution of jumps. On the other hand, performance reductions can occur due to the sharp rise in total body weight, possibly arising from extra amounts of body water carried along with the creatine and muscle glycogen molecules.

Creatine Supplementation and Speed Shots (Sprints) Training

Besides, creatine supplementation can be useful in optimizing performance in single sprints and consecutive sprints (5). The results appear to be more evident when sprinting times range from six to 30 seconds, with recovery periods around 30 seconds to five minutes between sprints **[10]**.

Eight physically active but untrained men underwent five days of creatine and dextrose supplementation (30g creatine + 30g dextrose daily). Before and after supplementation, the subjects were tested on a cycle ergometer (bicycle with air brakes), and the exercise protocol consisted of pedaling 20 seconds as fast as possible. The variables analyzed during the test were the power peak, average power during the trial, the instant of maximum potential, and percent of power drop. There were no significant effects ($p < 0.05$) on the variables analyzed during the test, and five days of creatine supplementation did not cause changes in performance during sprints of the 20s on a stationary bicycle **[31]**.

Handball athletes (n = 9) were supplemented with 20g / day of creatine for five days. Speed running tests were applied in the pre- and post-supplementation periods, consisting of six maximum sprints of 15 meters, separated by 60 seconds of rest. No reductions were observed in the total mean time over the entire 15 meters; however, the mean time required to cover the first five meters decreased significantly (1.05±0.03 seconds to 1.03 ± 0.03 seconds) ($p < 0.05$) **[27]**.

Another study analyzed the performance of consecutive sprints on an exercise bicycle using seven untrained healthy men, being supplemented for five days (20g / day of creatine).

The exercise protocol consisted of performing several series of sprints of six seconds, separated by periods of recovery and varied loads, during the total time of 80 minutes. The study aimed to physiologically reproduce the demands imposed during football matches or ice rock. The total work had a significant increase ($p < 0.05$; 6%) comparing the pre-supplementation period (251.7 ±18.4 KJ) to post-supplementation (266.9 ±19.3 KJ). In the same way, the maximum peak power increased during all the exercise series, obtaining significant increases ($p < 0.05$) in the series 1, 4 and 7 (rest between sets of 24s), 3 and 9 (rest between series 54s), 5 and 8 (rest between series of 84s) **[13]**.

Numerous researches use supplementation protocols at an average interval of five days; however, the use of only three days seems feasible to lead to increases in performance, as in the study by Ziegenfuss et al. **[22]**, where male and female athletes were supplemented with 20g / day of creatine for three days. The exercise protocol consisted in the performance of six maximum sprints of ten seconds in an ergometric bicycle, with a load corresponding to 0.10 kg/kg body weight. The maximal peak power increased significantly ($p < 0.01$) in the creatine supplemented group between sprints 2 to 6. The maximum power of the men was higher in sprints 1 and 2, while the women presented higher power during races 4, 5 and 6, leading the authors to conclude that among the athletes submitted to this study, women demonstrated better performances during consecutive sprints **[22]**.

The physiological characteristics of the sprints, explicitly analyzing the energetic metabolism involved, are dominated by anaerobic energy systems (ATP-PC and lactic anaerobic), with little influence of the aerobic system. Very short sprints (<8s) have a predominance of the ATP-PC system, while mean races (10-30s) are used for both systems, with the predominant anaerobic lactic system. In addition to these factors, creatine supplementation causes potential ergogenic effects in the performance of single and consecutive sprints **[32-33]**.

Discussion

Adherence to appropriate eating habits and the routine of structured training may be sufficient to achieve the desired goals, both for aesthetic and competitive purposes. However, to optimize performance in distinct physical activities, mainly activities with anaerobic energy systems predominance (ATP-PC and anaerobic glycolysis), and the use of creatine as an ergogenic supplement may show as significant importance.

The results that creatine supplementation may cause in performance are: increase of maximum and average power of maximum power during single and repetitive series of exercises in ergometric bikes, isokinetic and hydraulic resistance devices, increase in maximum lo and in the number of maximal repetitions after short rest periods, (3) reduction of the time of single sprints and consecutive sprints, reduction of recovery time after consecutive series of anaerobic exercises.

Because creatine is a synthesized amino acid by the body, its intake through dietary supplements seems to cause few side effects, and some individuals submitted tohigh dosage supplementations have demonstrated small intestinal problems such as pain. However, there is no scientific evidence that creatine can cause damage to internal organs such as the liver and kidneys.

Furthermore, the evidence found in the literature and presented in this research are categorical and, to a certain extent, indisputable in some of its results, such as the use of creatine supplementation to optimize performance in predominant anaerobic activities of the ATP-PC system and subsequent lactic anaerobic.

Conclusion

In conclusion, the use of creatine supplementation seems to be capable of bringing about performance improvements in activities with anaerobic predominance; however, intermittent aerobic exercises may also benefit. Due to the high demand for studies, which obtained favorable results in the performance of physical activities, creatine supplementation as an ergogenic resource is a great value, likewise due to the lack of concrete arguments regarding adverse reactions, few restrictions on its intake, proving to be an effective supplement for both the athletic community and non-competitive exercise practitioners.

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