Effects of creatine ingestion on body composition and on the supine exercise performance

Adriano da Costa Dias  
Mestrando em Ciência da Motricidade Humana – UCB  
adrieda@superig.com.br

Edésio Fazolo  
Mestrando em Ciência da Motricidade Humana – UCB  
edesiol@uol.com.br

Jairo José Monteiro Morgado  
Exército Brasileiro

ABSTRACT: Creatine supplying effects have been demonstrated in many studies. This substance may be used to the increase of force and speed in activities that use it as a source of predominant energy in the energetic alatical system, that is, ATP-PCr and also would be the responsible by the increase of thin dough, due to the hydric retention which is induced by it. The mean of this research was to verify the influence of CR supplying on the body mass and on the supine exercise performance of Brazilian Army militaries.

The sampling was composed by 20 male militaries (20.1 more or less 20.8 years old), in a randomic way of two experimental groups (CR group) and the regulate one (placebo group[PI]). The subjects executed the supine exercise in maximum of repetition (70% largest force, 1 RM) before and after the CR or PI supplying. The CR group ingested 20 grammes of creatine a day (4 doses of 5g) during five consecutive days and the PI group ingested the amount equivalent of PI (maltodextrine) during the same period of time. The body composition was measured before and after the supplying. The total body mass (MCT) increased on the CR group and the percentage of body fatness decreased on the CR and PI groups. The performance of supine exercise increased on the CR group (12 to 16.3 repetitions; p<0.05). It can be concluded that the results founded in this investigation suggested that the ingestion of creatine brings on a MCT improvement and a relief on the Brazilian Army militaries on supine exercises.

Keywords: supplying, creatine, ergogenic, body total mass, supine.

Correspondence to: Adriano da Costa Dias adrieda@superig.com.br

Submitted: September / 2003  
Accepted: October / 2003

Copyright© 2003 por Colégio Brasileiro de Atividade Física, Saúde e Esporte
Efeitos da ingestão de creatina na composição corporal e na performance do exercício supino

INTRODUCTION

It is increasing the number of athletes who want to improve their performance using some alimentary supplement of probable ergogenic effect. These supplements can be found in some business and are sold freely. The supplement that is getting prominence between the athletes, especially the body-building practitioners, is the creatine (Cr). In a research made with adolescent athletes, Blessing (2001) evidenced that, from one sample with 641 athletes, 84 confirmed the use of Cr, that is, 13.1%. Williams (2000, p.10) displayed that more than 90% of the North Americans athletes, especially the body-building practitioners, consume Cr regularly.

The benefits of the oral supplementation with Cr have been evidenced in literature through the reduction of the fatigue in activities of repetitive turns and for the increase of the strength and muscular power. Besides these effects, the increase of the supplies of Cr can offer therapeutic benefits through the prevention of the depletion of adenosine triphosphate (ATP), stimulation of the protein synthesis or reduction of the protein degradation, and stabilization of the cellular membranes (PERSKY, 2001).

The Cr is a substance that can be gotten through the endogenous production or consumed through the diet, being the main origin, the MEAT and milk. Approximately from one to two grammes of Cr is synthesized per day through the amino acids arginine, glycine and methionine, in the liver, the kidneys and the pancreas (WILDER, 2001). In an person with 70 kg of body weight, the normal daily consumption comes close to two grammes, being one gram synthesized endogenously and one gram gotten through exogen origins (BLESSED, 2001; WILLIAMS, 2000). In a man, approximately 95% of the total content of Cr are deposited in the skeletal muscle, in which 60 to 70% are linked to the phosphate molecule (p), forming the creatine phosphate or phosphocreatine (PCr). From 30 to 40% remains are in free form (BALSOM, 1994, P.268; CLARK, 1996, P.33). Other tissues that contain significant amounts of Cr belong to the heart, the testicules, the retina and the brain (MUJlKA; PADILLA, 1997; VOLEK, 1997).

The PCr is stored in small amount in the muscular cell, and the energy generated for its disintegration is used for resynthesis of ATP, from diphosphate of adenosine (ADP) and inorganic phosphate (Pi) (FOX, 1991, P.19). The Cr is essential in the process of regeneration of the ATP because two thirds of the Cr is phosphorylated by the creatine enzyme kinase (CK) to form the PCr. During explosive exercises, the phosphate of the PCr is set free to supply energy resynthesis of ATP, as it can be observed in the following example:

\[ \text{ADP} + \text{PCr} + \text{H}^+ \xrightleftharpoons{\text{CK}} \text{ATP} + \text{Cr} \]

The energy derived from the degradation of the PCr allows the pool of ATP be kept during an intense exercise that lasts, in the maximum, 30 seconds. The PCr acts as a temporary supplier of energy during periods of intense muscular contraction, when the ATP consumption exceeds the synthesis. Although there are from three to four times more PCr in the muscle than ATP, the PCr is also limited and requires replacement so that exercises of high intensity can be kept (WILLIAMS, 2000, p.19). The oral supplementation...
with Cr is connected to the increase of the storage of muscular PCr, to the increment of the regeneration of PCr during the recovery after an exercise, to the increase of the tax of resynthesis of ATP and to the possibility of reducing the relaxation time after a muscular contraction (LEMON, 2002). According to Alves (2002), the fatigue during the exercise can be attributed to the fast decrease of PCr. A fast recovery of the supplies of PCr would increase the ATP formation, improving the performance in sports that demand high power, speed or strength. Corroborating, Greenhaff (1995) suggests that the exercises of high intensity, that use the reserve of muscular phosphagens, seem to be more appropriate to try an increase of performance through the supplementation with Cr. The supplementation with Cr many times is made indiscriminately and without the orientation of a competent professional. According to Alves (2002), the dose habitually used is a load from 20 to 30 grammes daily, divided in four to six equal doses, during five to seven days, followed by doses of maintenance, from two to five grammes per day.

The results of the research with supplementation of Cr do not present uniformity in relation to the improvement of the performance and alterations in the body composition. The findings of Wiroth (2001) indicate that the oral supplementation of Cr in untrained men does not influence the isometric strength positively, but can increase the muscular anaerobic power. Earnest (1995), on the other hand, affirms that the supplementation of Cr increases the performance of the intermittent exercise of high intensity and the strength, but not the exercise of endurance. Becque (apud Machado, 2002) brings to light the increase of the total body mass (MCT) and of the lean mass as a result of the supplementation with Cr. In contrast, Deutekom (2000) described an increase of 2.9 kg in the MCT in individuals supplemented with 20 grammes of Cr for six consecutive days. As the Cr is a substance osmotically active, the increase of lean body mass would occur in part because of the hydric retention in the muscular cell (AXE, 2002).

Few studies relate the collateral effect of the supplementation with Cr, and between the possible consequences are the put on weight, the influence in the insulin production, the inhibition of the synthesis of endogenous Cr, and damages in the medium term in the renal function (BENZI, 2001) and hepatic, as for example hepatitis for poisoning trough medicines (BUCK, 2003). Little is known on the effect of the supplementation in the long term, what makes inappropriate the use of this substance for a long period. The objective of this research was to verify the influence of the supplementation with Cr in the body composition and the performance of the supine exercise in Brazilian Army militaries.

**METHODS**

**Type of research**

The present inquiry consists of an experimental research. This type of study describes what the phenomenon is going to be when certain factors are meticulously controlled. The approach of this research is directed by the cause-effect relations; the variable can be carefully manipulated with the intention to determine its influence. This study presents an individual methodology in terms of application of the logic and the planning or model of the experiment. Its starting point is always the hypothesis. Its process is evidence or refutation of the hypothesis, controlling the variable, it is possible to manipulate the independent one (SALOMON, 1999).

**Sample**

The sample consisted of 20 militaries of the masculine sex and they participated of the study as volunteers. All of them signed the Term of Free and Clarified Assent, in which the benefits and possible risks to the health associated to the experiment were explicit, and the possibility of being ruled out at any time of the research. The sample had an average age of 20.1 ± 2.8 years; a body mass of 71.58 ± 12.7 kg and the percentage of 10.86 fat was of ± 3.7%. They had been divided, at random, in group of control (Pl) and experimental group (Cr), both with 10 people. The individuals did not know the group belonged to. This work followed the Norms of Accomplishment of Research in Human beings, Resolution number 160/96 of the National Advice of Health, of 10/10/1996.

**Preliminary tests**

The body mass, the fat mass, the lean mass, and the percentage of fat had been gotten before and after the experiment. The test of a maximum repetition (1RM) in the straight supine exercise was made 48 hours before the pretest. The referred test was executed in a straight bench with the person lying down in the position of dorsal decubitus. The bar, with the estimated load, was placed on the palm of the hands of the participant and on the chest. From this position, the military man made a repetition. For those who executed more than one repetition it was given an interval of five minutes and after that the test was repeated adding more weight. There were not situations in which a third attempt was needed. The result found was considered as the maximum load for the participant.

**Experimental drawing**

The two groups executed the pretest. This test consisted of the straight supine exercise using a load of 70% of 1RM. The exercise was executed on a straight bench with the participant lying down in the position of dorsal decubitus. The bar was placed by two assistants on the hands and the chest of the participant, who initiated the exercise. Each military executed the maximum of repetitions in the exercise until the fatigue. Fatigue is considered the moment when the person stops the movement or when this one interrupts the movement with the arms stretched for more than one second. After the accomplishment of the pretest, the supplementation was initiated. The group of control made use of maltodextrin and the experimental group, made use of Cr. At the end of the period of consumption (five days) it was executed the after-test in both groups that consisted of the supine exercise applied in the same conditions of the pre-test.
Placebo and Creatine

The Cr and the maltodextrin were packed separately in identical containers of five grammes. The members of the group of control received placebo (maltodextrin) and the members of the experimental group received the Cr. The participants were guided to mix a dose of 5g of the substance with water (250 ml) to effect the ingestion. The two groups ingested four daily doses of 5g, totaling 20g daily, during five consecutive days. The participants were guided not to practice any type of physical exercise during the period between the daily pre-test and the after-test.

Instruments

The total physical weight was measured by a Filizola scale, with precision of 0.1 kg. The cutaneous folds were measured by a pair of compass of cutaneous folds by Cescorf, with constant pressure of 10g/mm in the faying surface and preciseness of 0.1 mm. The equation used for the calculation of the body density was of Pollock and Wilmore (1993), the folds used were: pectoral, abdominal and thigh. The formula for the calculation of the percentage of fat was proposed by Siri (1961).

Analysis and statistics

It was used the Descriptive Statistics in order to characterize the studied sample. The analysis of the results was made through the test t of Student for dependent samples. The level of significance was of p < 0.05, that is, 95% of certainty for the affirmations and/or negations that the present research possibly denotes.

RESULTS

The body mass increased in the group Cr (76.74 ± 4.68 for 77.90 ± 4.73 kg, for p<0.05) whereas the fat mass decreased in the group Pl. (6.78 ± 0.65 to 5.80 ± 0.54 kg, for p<0.05). The body lean mass increased in the group Cr (67.16 ± 2.99 for 68.86 ± 3.02 kg, p<0.05). The percentage of fat body decreased significantly in the groups Cr and Pl (11.67 ± 1.50 for 10.75 ± 1.66% and 10.05 ± 0.76 for 8.60 ± 0.66%, respectively, p<0.05). (Table1). The performance in the supine exercise increased significantly in the group Cr (12 for 16.3 repetition; p<0.05) (Table 2).

DISCUSSION

The MCT, in the present study, increased 1.16 kg in the group supplemented with Cr. In the researches presented by Volek (1997) and Warber (2002), it was executed the ingestion of Cr with 25 and 24 grammes daily, respectively, during five consecutive days, the increase of MCT was 1.4 Kg. Izquierdo (1998) effected a supplementation with Cr during five days, utilizing a daily dose of 20 g and obtained as a result an increase of 0.6 kg in the MCT. Kilduff (2002) described an increase of 1.2 kg using a dose of 20 grammes daily during five days. Huso (2002), also using a dosage of 20 grammes daily during five days and a dose of maintenance (2 grammes during 17 days) obtained an increase of 1.6 Kg in the MCT. Utilizing a higher dose (30 grammes daily during 4 weeks) Mckenna (1999) obtained an increase of de 2 kg in the MCT. The increase in the MCT recorded in the present research occurred because of an increment in the lean mass and this one seems not to be related to the muscular hypertrophy, because according to Machado (2002) the Cr is a substance osmotically active, and an increase in the intracellular concentration of Cr may, probable, induce an incorporation of water in the tissue. This hydric retention may generate significant increase in the lean mass.

In a variety of researches in which was utilized the supine exercise as an instrument, the group supplemented with Cr presented significant increase in the strength of the upper limbs. In a research made by Huso (2002), the test of 1RM of the supine exercise increased 33±8 kg after the training with weights during four weeks and of the supplementation with Cr (20 grammes daily during four days plus two grammes daily during 17 days). Izquierdo (1998) and Warber (2002), utilizing a dose de 20 e 24 grammes daily of Cr during five days showed, in their researches, that in tests of maximum repetitions in the supine exercise the magnitude of the increase of the number of repetitions was 21% and 14%, respectively. The present investigation found an increase in the number of repetitions in the supine exercise in participants supplemented with Cr. This result is probably related to an increment in the concentration of muscular PCr, what makes possible an elevation in the level of resynthesis of ATP. These data suggest that the Cr provide an ergogenic effect because its supplementation may delay fatigue in the exercise of arm of high intensity.

Table 1 - Variation of the body mass, fat mass, lean mass and percentage of fat

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Mass, kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pl</td>
<td>10</td>
<td>66.42±2.54</td>
</tr>
<tr>
<td>Cr</td>
<td>10</td>
<td>76.74±4.68</td>
</tr>
<tr>
<td>Fat Mass, kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pl</td>
<td>10</td>
<td>6.78±0.65</td>
</tr>
<tr>
<td>Cr</td>
<td>10</td>
<td>9.57±1.72</td>
</tr>
<tr>
<td>Lean Mass, kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pl</td>
<td>10</td>
<td>59.63±2.05</td>
</tr>
<tr>
<td>Cr</td>
<td>10</td>
<td>67.16±2.99</td>
</tr>
<tr>
<td>Percentage of Fat %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pl</td>
<td>10</td>
<td>10.05±0.76</td>
</tr>
<tr>
<td>Cr</td>
<td>10</td>
<td>11.67±1.50</td>
</tr>
</tbody>
</table>

*significant in relation to T1, p<0.05 T1 pre-test T2 – after-test

Table 2 - Variation of the maximum number of repetitions in the supine exercise

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>T1</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetitions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pl</td>
<td>10</td>
<td>13.7±1.39</td>
<td>15.2±1.94</td>
</tr>
<tr>
<td>Cr</td>
<td>10</td>
<td>12.0±0.97</td>
<td>16.3±1.32*</td>
</tr>
</tbody>
</table>

* significant in relation to T1, p<0.05; T1 – pre-test ; T2 – after-test.
CONCLUSIONS AND RECOMMENDATIONS

It is possible to conclude that there was an increase of the lean mass that probable occurred because of hydric retention in the muscle and also because there was an increase in the strength of the upper limbs and in the MCT of Brazilian army militaries who ingested during five consecutive days the amount of 20 grammes daily.

It is recommended that for future researches the utilization of a female sample and this is because most of the researches about ingestion are developed with men. It is important to control the diet of the sample, mainly the ingestion of proteins. It is suggested the collection of samples of the participants’ urine to measure the levels of creatine excreted and a biopsies in order to verify the relationship between the concentration of PCr before and after the supplementation and also to compare the concentration of this substance with the amount of creatine excreted.

REFERENCES


