The influence of oral monohydrated creatine intake for physical performance of military people in continuous combat operations

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ABSTRACT: In the world of sports, the growing competitiveness has led athletes and scientists through a search for other means to achieve a better performance, in addition to the new trends in physical training methodology. Such methods are known as Ergogenic Aids (Williams; Branch, 1998), among which it is creatine intake. These aids can be used in combat, since in many situations it requires the same physical gestures and performance similar to sports. What would be the influence caused the oral monohydrated creatine intake over the physical performance of military people under exhausting four-day continuous combat operations (CCO)? With the aim at answering such a question, a group of 32 volunteer male military, aged (X±dp) 21.97%±2.19 went through CCO simulations during four days under the following protocol: Group (Gr1) received 20g of creatine, seeing that n=12; Group 2 (Gr2) received a mixture of 20g of creatine and 160g of maltodextrin, seeing that n=9; Group 3 (Gr3) did not receive any type of supplement, seeing that n=11. The dependent variables of physical performance Ratio of Perceived Exertion (RPE), Lean Body Mass (LBM), Strength Power (SP), Anaerobic Muscle Endurance (AME) and Alactic Anaerobic Power (ALP) were evaluated in the previous and pre- and post-tests and then compared. After CCO, Gr1 and Gr2 were expected to show a smaller but significant decrease (p<0.05) when compared to Gr3 in its physical performance. Creatine intake might justify this fact. However, there was no significant difference among the groups in relation to the analyzed variables. Therefore, it was concluded that creatine intake did not produce any ergogenic significant effect in the analyzed samples.

Keywords: creatine; continuous combat operations; physical performance.

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CREATINE IS A NATURAL COMPONENT ENDOSYNTHETICALLY DEPOSITED IN THE SKELETAL MUSCLE, THE 60 TO 70% REMAINING ARE FOUND TIED TO THE PHOSPHATE MOLECULE (P), FORMING THE INTRAMUSCULAR CREATINE-PHOSPHATE. THE 30 TO 40% REMAINING ARE FOUND FREELY, AND ABOUT 2 GRAMS, THROUGH THE ENDOGENOUS AND EXOGENOUS SOURCES.

According to Bollote (1998), the normal daily needs of creatine are about 2 grams, through the endogenous and exogenous sources, to replace the catabolized creatine, which is excreted through the kidneys as creatinine.

In the human beings, approximately 95% of the total contents of creatine are deposited in the skeletal muscle, whose 60 to 70% are bound to the phosphate molecule (P), forming the creatine-phosphate. The 30 to 40% remaining are found freely (Balsom, 1994:268; Clark. 1996:33). Other tissues which contain significant quantity of creatine are heart, testicles, retina and brain (Mujika; Padilla, 1997).

The intramuscular creatine-phosphate (PCr) plays a major role in the energetic metabolism during the contracture of the skeletal muscle and recovery, as responsible for the adenosine triphosphate (ATP) resynthesis, from the adenosine diphosphate (ADP) during the exercises of short during and high intensity.

ARGININE, GLUTAMINE AND METHIONINE (Williams, 2000:8). Besides the endogenous synthesis, the creatine is also found in mixed diet, mainly in the fish, meat and other animal product, and it is intact absorbed in the intestine (Plisk; Kreider, 1999).

At war, the time factor is prevalent for the success of operations. This can be seen in the macro level, i.e., in the decisions from the high rank commandoes, or micro, as for example in the time spent by a combatant in order to accomplish a combat action. In both cases, the speed is a prevalent factor between life and death. Therefore, any slight improvement in performance may lead to a substantial difference in the success of operations.

Among the nutritional substances suspect of providing some improvement in the physical performance, the Creatine has become one of the most popular substances in the past years. In a study conducted with adolescent athletes, by Blessing, Handinger and Willford (2001), it was verified that from a sample of 641 athletes, 84 reported having made use of this substance for some improvement of athletic performance, i.e., 13.1%.

Increase effects of this are based on the theory that the supplementation might increase the strength and velocity in sports, in which the prevalent source of energy was deriving from the ATP-CP Energetic System.

Creatine is a natural component endogenously synthesized in the liver, pancreas and kidneys by means for the amino acids: arginine, glycine and methionine (Williams, 2000:8). Besides the endogenous synthesis, the creatine is also found in mixed diet, mainly in the fish, meat and other animal product, and it is intact absorbed in the intestine (Plisk; Kreider, 1999).

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INTRODUCTION

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via the action of the creatino kinase enzyme (CK) (Mujika; Padilla, 1997).

Williams (2000:21) affirmed that two thirds of Cr stored in the muscle are phosphorylated by the CK enzyme to form PCr, seeing that during the rapid exercise, the phosphate for the PCr is cleft to supply energy for the ATP resynthesis. The energy derived from degradation of PCr allows the ATP pool to be recycled more than 12 times during a supramaximal exercise.

Once the capacity of resynthesizing ATP, and then producing energy, is reduced, when the reserves of PCr are depleted to a certain level, the availability of PCr for the muscular contracture has been considered as a limiting factor in exercises of high intensity and short duration. In addition, the supply of phosphates of high energy – ATP and PCr – is restricted, seeing that the sufficient total to endure high intensity exercises for about 10 seconds. That being so, the increase of total concentration of Cr in the muscle might limit the depletion of PCr reserves during intense muscular exercises, restricting also the decrease in the ATP resynthesis by the increase of the ADP rephosphorylation. The potential benefits of this mechanism in the performance have been remembered to justify the oral administration of Cr supplementation.

Several strategies of supplementation have been used to promote the increase of total quantity of Cr, mainly PCr, in the muscle. The more commonly used dose corresponds to 20g to 30g of Cr daily, divided between four to six equal doses during the period from four to seven day. According to some authors, these quantities would be sufficient to rise up to the maximum levels of Cr reserves in the muscle (Balsom, 1994; Harris, 1992; Hultman, 1996; Nelson, 2001).

Verifying the ergogenic effect attributes to the Cr intake, it was raised the questionings: it may be increasing the physical performance in combat situations rising the Cr levels in operational ration, considering that the ration does not contain Cr sufficient quantities to promote the total rising of this substance contained in the organism to the maximum levels.

Objectives
It aimed at examining the effect of the administration of a dose of Cr and Cr plus maltodextrin over the physical performance characterized by the morphofunctional parameters of physical performance Ratio of Perceived Exertion (RPE), lean body mass weight (LBWM), Rapid Strength (RS), Local Anaerobic Muscular Endurance (LAME) and Alactic Anaerobic Potency (AAP) of military people of the Brazilian Army (cf. Table 1), when subjected to simulations of continuous combat operations.

Variables
It was taken into consideration as an independent variable the dose of Cr and Cr plus maltodextrin, which could be considered of quantitative nature, as its values presented in the continuous form. It was also recognized as dependent variables, the morphofunctional parameter (RPE, LBMW, RS, LAME and AAP), which served to characterize the physical performance, seeing that classified as quantitative ones and continuous distribution.

Study delimitation
The present study was set to 32 male military people, meat-eaters, aged 19-26, and residents in the city of Rio de Janeiro, education – Elementary School, standardized from the Brazilian Army.

Hypotheses
The hypotheses were declared in the null and alternative form p<0.05, i.e., 95% of certainty for the affirmatives and/ or negatives which the study comes to demonstrate. The substantive hypothesis anticipated that, after simulations of continuous combat operations, the occurred medications in the morphofunctional parameters of the groups that during such simulations the individuals swallowed Cr (group1), Cr plus maltodextrin (group 2) and the control group (group 3), it would not be equivalent.

### Table 1 – Analyzed morphofunction parameters, protocols and used tests in the evaluation

<table>
<thead>
<tr>
<th>Morphofunction evaluation parameters</th>
<th>Protocols</th>
<th>Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body density</td>
<td>Pollock &amp; Wilmore (1993)</td>
<td>Mensurate of thoracic cutaneous skinfold, abdominal and thigh and the use of formula no.1</td>
</tr>
<tr>
<td>Fat percentual</td>
<td>Siri (1961)</td>
<td>Use of formula no.2</td>
</tr>
<tr>
<td>Lean body mass weight</td>
<td>De Rose (1984)</td>
<td>Use of formula no.3</td>
</tr>
<tr>
<td>Rapid Strength</td>
<td>-----</td>
<td>Hand grenade throw</td>
</tr>
<tr>
<td>Muscular endurance</td>
<td>Pollock &amp; Wilmore (1993)</td>
<td>Arm push-up on the ground</td>
</tr>
<tr>
<td>Anaerobic location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alactic Anaerobic Power</td>
<td>Maris (1999)</td>
<td>Test of 10 successive jumps</td>
</tr>
<tr>
<td>Fatigue Subjective Perception</td>
<td>Borg (1999)</td>
<td>Borg’s CR10 Scale</td>
</tr>
</tbody>
</table>

Formulas:
1 - DC = 1.1093800-0.0008267(X3) + 0.00000016 (X3) 2 – 0.0002574 (X6)
X3 = sum of cutaneous thoracic, skinfold, abdominal and thigh
X6 = age in years
2 – % G = [(4.95/DC) – 4.5) X 100
3 – Weight x Fat percentage = Absolute Ft
Weigh – Absolute Fat = Lean Body Mass
METHODOLOGY

Sample
After having been applied the criteria of inclusion and exclusion, and aiming at guaranteeing a homogeneous composition, other military people of the same military people, rank and occupation were drawn to replace the participants excluded from the sample. The 32 male individuals were meat-eaters, aged 19-26, residents in the city of Rio de Janeiro, education – Elementary School, standardized from the Brazilian Army, seeing that they were military people who belong the parachute infantry. They were disposed in three groups: Cr (G1) with n=12, Cr plus maltodextrin (G2) with n=9, and the control group (G3) with n=11.

Ethics of the study
This study was conducted in compliance with the Norms for the Completion of Research on Human Beings according to the Brazilian Health Laws.

It is important to highlight that this research was submitted the analysis of the Committee of Ethics in Research on Human Beings of the Castelo Branco University.

Procedures of the data collection
After the selection of individuals and before the beginning of the procedures, the groups swallowed: G1 – 20g of monohydrated Cr daily, divided into four intakes, during four days; G2 – 20 g of monohydrated Cr mixed with 160g of maltodextrin, divided into four daily intake of 45g of mixture, during four days; and G3 did not swallow any product, not even a placebo, i.e., it only fed on operational ration. The groups G1 and G2 swallowed the respective products at 10am, 2am, 6pm and 10pm, following an interval of four hours between each intake and two hours between each intake and meals.

During the period of supplementation, the individual were submitted to four day of simulations of continuous operations of combat, seeing that the first day of planning for the missions that would be accomplished in the following 72 hours. Upon

Table 2 - Quantities of micro- and macronutrients contained in each portion of the operational ration, type AE of the menu option nº 2

<table>
<thead>
<tr>
<th>Quantity PER PORTION (1 MENU)</th>
<th>Caloric value</th>
<th>Carbohydrates</th>
<th>Proteins</th>
<th>Total fat</th>
<th>Total saturated fat</th>
<th>Cholesterol</th>
<th>Dietary fiber</th>
<th>Calcium</th>
<th>Iron</th>
<th>Sodium</th>
<th>Creatine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1490kcal</td>
<td>256g</td>
<td>41g</td>
<td>33g</td>
<td>10g</td>
<td>70mg</td>
<td>5g</td>
<td>421mg</td>
<td>6.86mg</td>
<td>2980mg</td>
<td>64mg</td>
</tr>
</tbody>
</table>

Menu nº 2 Breakfast or supper: coffee and milk, pineapple jam and water and salt crackers. Lunch or dinner: chicken risotto, passion fruit juice, crystallized banana

Table 3 - Quantities of micro- and macronutrients contained in each portion of the operational ration, type AE of the menu option nº 3

<table>
<thead>
<tr>
<th>Quantity PER PORTION (1 MENU)</th>
<th>Caloric value</th>
<th>Carbohydrates</th>
<th>Proteins</th>
<th>Total fat</th>
<th>Total saturated fat</th>
<th>Cholesterol</th>
<th>Dietary fiber</th>
<th>Calcium</th>
<th>Iron</th>
<th>Sodium</th>
<th>Creatine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1630kcal</td>
<td>306g</td>
<td>35g</td>
<td>30g</td>
<td>9g</td>
<td>25mg</td>
<td>6g</td>
<td>456mg</td>
<td>8.31mg</td>
<td>3020mg</td>
<td>92mg</td>
</tr>
</tbody>
</table>

Menu nº 3 Breakfast or supper: cappuccino, orange jam and water and salt crackers. - Lunch or dinner: rice and vegetables and meat, tangerine juice, jelly candy.

Table 4 – Mean and standard deviations LBMW, RS, LAME and AAP in the pre-test

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>MEANS AND SD</th>
<th>LBMW (kg)¹</th>
<th>RS(m)²</th>
<th>LAME(nr)³</th>
<th>AAP(m/s)⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>X± dp</td>
<td>62.52 ± 6.25</td>
<td>23.68 ± 5.06</td>
<td>35.67 ± 8.73</td>
<td>2.89 ± 0.22</td>
</tr>
<tr>
<td>G2</td>
<td>X± dp</td>
<td>63.25 ± 8.34</td>
<td>23.03 ± 6.53</td>
<td>41.56 ± 8.49</td>
<td>2.91 ± 0.27</td>
</tr>
<tr>
<td>G3</td>
<td>X± dp</td>
<td>60.07 ± 5.66</td>
<td>23.07 ± 4.88</td>
<td>33.64 ± 9.58</td>
<td>2.78 ± 0.16</td>
</tr>
</tbody>
</table>

¹ - KG, 2 - Meters, 3 - Number of replicates 4 - Meters per second

Table 5 – Mean and standard deviations LBMW, RS, LAME, and AAP in the pre-test

<table>
<thead>
<tr>
<th>GROUPS</th>
<th>MEANS AND SD</th>
<th>LBMW (kg)¹</th>
<th>RS(m)²</th>
<th>LAME(nr)³</th>
<th>AAP(m/s)⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>X± dp</td>
<td>63.38 ± 6.37</td>
<td>22.91 ± 3.26</td>
<td>33.33 ± 4.91</td>
<td>2.91 ± 0.21</td>
</tr>
<tr>
<td>G2</td>
<td>X± dp</td>
<td>62.83 ± 8.10</td>
<td>28.48 ± 7.00</td>
<td>39.67 ± 8.08</td>
<td>2.99 ± 0.43</td>
</tr>
<tr>
<td>G3</td>
<td>X± dp</td>
<td>58.59 ± 4.43</td>
<td>21.64 ± 5.22</td>
<td>33.00 ± 6.57</td>
<td>2.97 ± 0.54</td>
</tr>
</tbody>
</table>

¹ - KG, 2 - Meters, 3 - Number of replicates 4 - Meters per second
the accomplishment of missions, the individuals were exposed to situations of high level of physical and mental with a mean of three sleeping hours per day. They fed on operational ration, whose quantities of macronutrients per portion which are shown in the Table 2, and water consumption ad libitum. Before and after the supplementation evaluation of morphofunctional parameter (pre- and post-tests) were conducted.

After the pre-test which coincided with the beginning of Cr intake, the individuals fed exclusively on the operational ration. Each military received two packages of daily ration (one with the menu option no.2 and the other one with the menu option no. 3), seeing that the second package was made up of breakfast and lunch or dinner and supper. The quantities of macro- and micronutrients contained in a portion of type AE are shown in the tables 2 and 3, having been analysed the content of Cr contained in it, from the furnished data by the maker and by means of data quote by Balson (1994).

Every 24 hour, it was examined the consumed content. For such, it was inspected what was left in the packages of ration and conducted an anamnesis with the individual, not seeing that the leftover considered relevant to the point of interfering in the results. Therefore, about 3120kg and 156mg of Cr were consumed.

**Data statistical treatment**

Means and standard deviations of descriptive statistic were used to characterize the studied sample.

**Graph 1 – Subjective perception of fatigue in the pre-test**

**Graph 2 - Subjective perception of fatigue in the post-test**

It was employed as a hypothesis testes a MANOVA 3x5 with repeated measurements in the second factor to test the null hypothesis and a level of significance (α) of 0.05, ie, a level of reliability of 95%, what allows to take a decision of rejection of null hypothesis considering p<0.05. The first factor, independent variables, were the groups (G1, G2 and G3), i.e., the different forms of ergogenic supplementation. The second factor independent variables of the study were RPE, LBMW, LAME and AAP, which served to characterize the physical performance.

**PRESENTATION AND DISCUSSION OF RESULTS**

The analysed sample was homogenous, seeing that this homogeneity detected upon the testing of null hypothesis by MANOVA 3XS, with repeated measures in the sector factor, which presented a Wilks’Lamdba=0.84 for p=0.79. Only it would admit the non homogeneity of groups if, upon the hypothesis testing, was obtained a level p<0.05, what did not occur.

The subjective perception of fatigue did not present normal distribution in the pre-test, not meeting therefore one of the objectives quoted by Vincent (1995) for the use of the test, having been used for its analysis the non parameter Kruskal-Wallis test. (Table 6 – Results of the statistical analysis of the means of the analysed variables)

<table>
<thead>
<tr>
<th>Tests</th>
<th>Dependent Variables</th>
<th>Value of P for the Rejection of Null Hypothesis</th>
<th>Found Values for p</th>
<th>Conclusion from the Statistic Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>MANOVA 3X5 parametric</td>
<td>LBMW</td>
<td>p&lt;0.05</td>
<td>p=0.79</td>
<td>Acceptance of null hypothesis</td>
</tr>
<tr>
<td></td>
<td>RS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LAME</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AAP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kruskal Wallis</td>
<td>RPE</td>
<td>p&lt;0.05</td>
<td>P=0.90</td>
<td>Acceptance of null hypothesis</td>
</tr>
<tr>
<td>Non parametric</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

The means (x) and standard deviation (dp) of four analysed variables by the parametric tests, and which would serve to characterize...
the physical performance (cf. Table 4). The graph 1 presents the results of pre-test for the variable RPE.

The variable RPE did not present variance in the pre-test, for all the individuals attribute grade 0 (zero) to the sensation of fatigue. As a consequence, it could not be produced a table of frequency for this variable in the pre-test.

**Presentation of post-test data**

The means (x) and standard deviations (dp) of four variables analysed and used to characterize the individual’s physical performance (cf. Table 5). The graph 2 presents the results of post-test for the variable PSE.

**DISCUSSION OF RESULTS**

As shown in Table 6, the application of the parametric test, with repeated measures in the second factor to test the null hypothesis at a level of significance (α) of 0.05, it might allow to take a decision of rejection of null hypothesis p<0.05, what did not occur, being accepted the null hypothesis. Therefore, the dose of Cr did not exercise significant ergogenic effect over the physical performance, which it was represented by the variables LBMW, RS, LAME and AAP.

The RPE was analysed by the non parameter Kruskal-Wallis test. The results of this test indiced that the dose of Cr and Cr plus maltodextrin also did not present significant ergogenic over this variable when analysed with the level of significance (α) of 0.05 (cf. Table 6), being therefore accepted the null hypothesis, i.e., a dose of Cr did not exercise the significant ergogenic effect over the perception subjective of fatigue.

**REFERENCES**


