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Dragan Radovanovic[1]
Milovan Bratic[1]
Dragana Milovanovic[2]

[1]**Faculty of Sport and Physical Education, University of Nis, Serbia**
[2] **Faculty of Chemical and Materials Engineering, University of Belgrade, Serbia**

EFFECTS OF CREATINE MONOHYDRATE SUPPLEMENTATION AND TRAINING ON ANAEROBIC CAPACITY AND BODY COMPOSITION IN JUDO ATHLETES

SUMMARY

The investigation aimed to determine the effects of the two-week creatine monohydrate supplementation and specially designed training program on anaerobic power and body composition in judo athletes. A total of 12 athletes was divided into the creatine (C) and placebo (P) groups. During the first week, the C group subjects (n=6) were given a prepared aqueous solution of creatine monohydrate and dextrose four times a day. During the second week, subjects were given the prepared solutions once a day. The P group subjects (n=6) were involved in the same protocol and at the same time were given only a dextrose solution. All subjects were included into specially designed training program composed of strength training and perfecting of specific judo techniques. The investigation protocol consisted of Wingate test for the upper extremities, the assessment of body composition and special judo fitness test (SJFT). The comparison of results between the groups before and after the process of supplementation showed a significant difference only in relation to the values of anaerobic capacity. The results were analyzed for each group alone before and after supplementation. In the C group subjects, there is a significant difference in the values of anaerobic power and fat mass percentage observed during the Wingate test, whereas no significant difference was found in the values of SJFT. Obtained results show that the two- week creatine monohydrate supplementation and specially designed training program, although of shorter duration than those described in the literature, have a significant effect on anaerobic power and body composition.

Key words: creatine, judo, anaerobic capacity, training

INTRODUCTION

Creatine monohydrate is the most effective ergogenic nutritional supplement currently available to athletes in terms of increasing high intensity exercise capacity and lean body mass during training (1,2). Creatine monohydrate is not on the List of prohibited substances of world anti-doping code WADA (3). There is no scientific evidence that the short- or long-term use of creatine monohydrate has any detrimental effects on otherwise healthy individuals (2,4). It is the position of the International society of sports nutrition that the use of creatine as a nutritional supplement within established guidelines is safe, effective, and ethical (2). At present, creatine monohydrate is the most extensively studied and clinically effective form of creatine for use in nutritional supplements in terms of muscle uptake and ability to increase high-intensity exercise capacity (1,2,5-7). The supplementation protocol most often described in the literature is referred to as the “loading” protocol. This protocol is

Corresponding author. Dragan Radovanovic • Phone: +381 18511940 ext.106 • E-mail: drdr@bankerinter.net

characterized by ingesting approximately 0.3 $g \cdot kg^{-1}BW \cdot day^{-1}$ of CM for 5-7 days (e.g., ~ 5 grams taken four times per day) and 3-5 $g \cdot day^{-1}$ thereafter (8,9).

Judo is characterized by short duration, high-intensity, intermittent exercise followed by a period of constant pulling, pushing, lifting, grappling and gripping movements in preparation for the next explosive effort (10). As a result, judo is often considered to be an explosive sport which demands great anaerobic strength and capacity (11,12), accompanied by a well-developed aerobic system (13). From the aspect of functional characteristics, competitive success to a great extent depends on the ability of the judoist to, within their own weight category, achieve higher levels of anaerobic capacity and manifest great muscle strength with quick recovery between successive matches (14,15). Previous investigations have shown that morphological and functional characteristics of judo athletes correlate with technical elements performed during a judo fight (16). For this reason, it is probable that the improvement in some of the mentioned variables may have a positive effect on the others. Analyzing high-energy phosphates using phosphorus-31 nuclear magnetic resonance spectroscopy (17), Gariod et al. (18) determined two dominant profiles of judo players: aerobic and anaerobic. Judo players winning mainly in the final moments of fight belong to the aerobic profile, while judo players winning mainly at the beginning of fight belong to the anaerobic profile. The decrease in the amount of phosphocreatine maximal voluntary contraction was smaller in the muscle of judo players with the aerobic profile than in those with the anaerobic one, while phosphocreatine resynthesis was faster in judo players with aerobic profile (18). Such results suggest that physiological and biochemical processes directly affect the way the fight progresses and the application of technical and tactical actions.

AIMS

The aim of the investigation was to determine the effects of the two- week creatine monohydrate supplementation and specially designed training program on anaerobic capacity and body composition in judo athletes.

MATERIAL AND METHODS

Subjects. A total of 12 judo athletes (age 23 years±4.1; body height 178.57cm±5.2) with several-year-lasting sport experience were divided into the creatine (C) and placebo (P) groups. During the first week (the "loading" phase), the C group subjects (n=6) were given a prepared aqueous solution of creatine monohydrate 0.3 $g \cdot kg^{-1}BW \cdot day^{-1}$ and dextrose 20 g per serving, four times a day. During the second week (the "maintenance" phase), subjects were given the prepared solutions (creatine monohydrate 0,3 $g \cdot kg^{-1}$BW and dextrose 20 g) once a day. The P group subjects (n=6), involved in the same protocol and at the same time were given only a dextrose solution (dextrose 20 g per serving). The investigation was performed in a single-blind, randomized fashion. The supplement solutions were prepared immediately before administration to all subjects, and the duration of the procedure was determined by the duration of common basic physical preparations.

All of the subjects were presented with the relevant information in written form regarding the aims, course, participation and possible unwanted side effects of the investigation. All of the subjects voluntarily gave their written consent to participate in the investigation, and underwent a general physical examination.

During the whole investigation, all subjects were included into specially designed training program composed of strength training with defined external loading exercises and perfecting of specific judo techniques.

Procedures. The investigation protocol consisted of laboratory Wingate 30-second cycle ergometer test for the upper extremities, the assessment of body composition (by bioelectric impedance analysis BIA), and special judo fitness test. The investigation protocol was performed at the beginning and one day after the supplementation process was over.

The anaerobic capacity parameters (peak power – PP and mean power - MP) were determined by the "all-out" 30-s anaerobic Wingate test (19,20). For this purpose, an arm cycle ergometer (Monark, Sweden) equipped with an electronic measuring device with a display was used. The setting up of the equipment and the subjects' warm-up carried out according to the standard (19). Data registration was carried out with the help of a specially designed computer program on the basis of the standards devised by the author of the test and the published technical description of a system for registering data by means of a computer (21). The Wingate test was carried out in the morning hours, at least 16 h after the last training, in a room where the temperature was 21-23°C, where the humidity was 55-60%, so that the microclimatic conditions followed the standards for functional lab testing (22,23).

The percentage of fat mass was measured by bioelectrical impedance analysis (24,25) and the device BF300 (Omron, Japan) was used. Data regarding percentage of fat mass were read off the display with an accuracy of 0,1%.

The Special Judo Fitness Test (SJFT) (26,27) was performed in training gym, at least 6 h after Wingate test, in the following sequence: two *Uke* judoists in the same weight category and of similar height were positioned at a distance of 6 m from each other, while the tested subject, *Tori*, stood in the middle between them. When the command *Hajime* was given, the *Tori* was required to run up to one of the *Ukes* and perform an *Ippon-seoi-nage* throw, followed by the same type of throw on the second *Uke*. This procedure was repeated for 15 s (series A), after which the *Matte* command was given, followed by a 10-s break. Series B and series C followed on after procedures was repeated for 15 s (series A), after which the *Matte* command was given, followed by a 10 s break. Series B and series C followed on after a second and third 10-s break. The heart rate was measured after 1 min rest, which followed immediately on the series A, B and C throws. The index for the SJFT was calculated according to the following equation: (HReff+ HRres)$(A+B+C)^{-1}$ where HReff and HRres are the heart rate following the effort, and 1 min after the test respectively, and A+B+C is the total number of throws effected in series A, B and C. The lower the index indicated, the better results.

Statistical processing. Depending on a statistical marker, measurement scale, type of distribution, and number and size of samples, the following tests were used: Student's t-test, Mann-Whitney U test, the Wilcoxon rank sum test, and the Wilcoxon test for paired samples. In order to process the results of the study, the SPSS statistical program for Windows (Release 10.0, Chicago, IL, USA) was used and $p<0.05$ was used as the accepted level of significance.

RESULTS

The results of investigation are presented in tables 1, 2 and 3. All results are presented as means±SD.

Table 1. Results of anaerobic capacity parameters determined by laboratory Wingate test

Parameter/ Group (period)	PP (W)	PP ($W \cdot kg^{-1}$)	MP (W)	MP ($W \cdot kg^{-1}$)
C (1)	711.52±84.62	9.62±0.94	506.88±61.26	6.86±0.82
C (2)	797.92±90.6*	10.54±0.99*	561.7±64.46*	7.42±0.7*
P (1)	704.76±76.92	9.44±0.8	500.96±62.36	6.7±0.76
P (2)	736.08±87.44	9.76±0.92	526.42±68.12	6.98±0.94

Legend: 1 - at the beginning; 2 - one day after the supplementation process; PP – peak power; MP – mean power; * p<0,05.

Table 2. Results of body weight and percentage of fat mass of judo athletes

Parameter/ Group (period)	Body weight (kg)	Fat mass (%)
C (1)	73.82±8.5	6.93±2.4
C (2)	75.7±8.7*	7.5±2.6*
P (1)	74.64±8.7	7.26±2.8
P (2)	75.42±8.9	7.4±2.7

Legend: 1 - at the beginning; 2 - one day after the supplementation process; * p<0,05.

Table 3. Results of judo athletes in the Special Judo Fitness Test (SJFT)

Parameter/ Group (period)	HReff (beats·min^{-1})	HRres (beats·min^{-1})	A+B+C (throws)	SJF Index
C (1)	182.44±8.6	154.66±12.28	23.4±2.1	14.61±2.1
C (2)	180.46±6.4	155.24±11.84	24.8±2.8	13.95±1.82
P (1)	183.12±7.8	156.36±13.1	24.2±2.5	14.18±1.96
P (2)	181.52±8.1	154.74±11.42	25.1±2.9	13.52±1.78

Legend: 1 - at the beginning; 2 - one day after the supplementation process; HReff - the heart rate following the test; HRres - the heart rate 1 min after the test; A+B+C - total number of throws effected in series A, B and C.

DISCUSSION

To date, several hundred peer-reviewed research studies have been conducted to evaluate the efficacy of creatine monohydrate supplementation in improving exercise performance. Nearly 70% of these studies have reported a significant improvement in exercise capacity, while the others have generally reported insignificant gains in performance (28).

Significant correlation between functional abilities and technical elements in judo means that the improvement in some of the physiological variables can positively affect the execution of techniques during a fight (28,29). An example of this is that the increase in anaerobic capacity along with the decrease in the percentage of fat mass enables the execution of a greater number of attacks during a fight, while the improvement in aerobic capacity enables a faster recovery process between fights (16,29).

The comparison of results of present investigation between the groups before and after the process of supplementation showed a statistically significant difference ($p<0.05$) only in relation to the values of peak power (C vs. P: absolute values 797.92W±90.6 vs. 736.08W±87.44; relative values 10.54W±0.99 vs. 9.76W±0.92) and mean power (C vs. P: absolute values 561.7W±64.46 vs.

526.42W±68.12; relative values 7.42W±0.7 vs. 6.98W±0.94) revealed during the Wingate test. The results were analyzed for each group alone before and after supplementation. In the C group subjects, there is a statistically significant difference ($p<0.05$) in the values of peak power (absolute values 711.52W±84.62 pre vs. 797.92W±90.6 post) and mean power (absolute values 506.88W±61.26 pre vs. 561.7W±64.46 post; relative values 6.86W±0.82 pre vs. 7.42W±0.7 post) observed during the Wingate test and body weight (73.82kg±8.5 pre vs. 75.7kg±8.7 post) and fat mass percentage (6.98%±0.94 pre vs. 7.42%±0.7 post), whereas no statistically significant difference was found in the specific fitness judo test. With regards to the investigated variables in the P group subjects, after two weeks there is no statistically significant difference in any of them.

Taking into consideration a designed training routine and nutrition, the increase in body weight and fatty tissue percentage in the subjects of both groups was expected. Since all subjects were involved in the same training process, under the same conditions of work, rest and nutrition, we consider higher values in the C group subjects determined by the standardized Wingate test a direct consequence of creatine monohydrate supplementation. The absence of differences in the performance of the specific fitness judo test can be explained by a poor correlation between laboratory and specific field tests (31).

Based on our results previously mentioned, and the tremendous number of investigations conducted with positive results from creatine monohydrate supplementation (2,6,32), we can conclude that creatine monohydrate is effective nutritional supplement for increasing high-intensity exercise capacity in judo athletes.

CONCLUSION

Obtained results show that the combination of specific judo training, strength training and two-week supplementation with creatine monohydrate, although of shorter duration than those described in the literature, have a significant effect on anaerobic capacity and body composition in judo athletes. It can be concluded that creatine monohydrate supplementation protocol, consisting of one-week "loading" and one-week "maintenance", leads to the increase in energy resources of anaerobic capacity, what is reflected in the increase of peak and mean values of expressed power during short-term and very intensive physical activity.

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EFEKTI SUPLEMENTACIJE KREATIN MONOHIDRATOM I TRENINGA NA ANAEROBNI KAPACITET I TELESNI SASTAV DŽUDISTA

Dragan Radovanović[1], Milovan Bratić[1], Dragana Milovanović[2]

[1]Fakultet sporta i fizičkog vaspitanja Univerziteta u Nišu
[2]Tehnološko-metalurški fakultet Univerziteta u Beogradu

SAŽETAK

Istraživanje je sprovedeno s ciljem da se ispitaju efekati dvonedeljne suplementacije kreatin monohidratom i posebno planiranog trening programa na anaerobni kapacitet i telesni sastav džudista. Ukupno 12 džudista bilo je podeljeno u kreatin (C) i placebo (P) grupu. Ispitanici C grupe (n=6) dobijali su tokom prve nedelje istraživanja, četiri puta dnevno, vodeni rastvor kreatin monohidrata i dekstroze. Tokom druge nedelje, ispitanici su pripremljene rastvore dobijali jedanput dnevno. Ispitanici P grupe (n=6) su po istom protokolu i u isto vreme dobijali samo rastvor dekstroze. Svi ispitanici su bili uključeni u posebno planirani trening program, koji se sastojao od treninga snage i uvežbavanja specifičnih džudo tehnika. Rastvori suplemenata su bili pripremani neposredno pre davanja svim ispitanicima, a dužinu trajanja procesa odredilo je trajanje zajedničkih bazičnih fizičkih priprema. Istraživački protokol sastojao se iz laboratorijskog Vingejt testa na biciklergometru za gornje ekstremitete, procene telesnog sastava i terenskog specifičnog džudo fitnes testa (SJFT). Poređenje rezultata između grupa, pre i posle procesa suplementacije, pokazalo je značajne razlike samo u vrednostima anaerobnog kapaciteta (maksimalna i prosečna snaga) ispoljenih tokom laboratorijskog Vingejt testa. Kod ispitanika C grupe, nakon suplementacije, utvrđena je značajna razlika u vrednostima anaerobnog kapaciteta i procenta masnog tkiva, dok nije bilo značajne razlike u vrednostima SJFT. Dobijeni rezultati ukazuju da dvonedeljni proces suplementacije kreatin monohidratom i posebno planirani trening program, iako kraći od opisanih u literaturi, imaju značajni efekat na anaerobni kapacitet i telesni sastav džudista.

Ključne reči: **kreatin, džudo, anaerobni kapacitet, trening**