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EFFECTS OF CREATINE MONOHYDRATE (CR) TO MUSCLE STRENGTH AND BODY COMPOSITION

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ABSTRACT

Aim of research was to examine the effects of consuming CR to muscle strength and body composition. Duration of experimental treatment was 8 weeks. Sample consisted of 14 participants aged 24±6months divided into two sub-samples: 6 participants who consumed CR and 8 participants who were placebo group. Strength was assessed using 3 tests: Bench Press 1RM, Leg Press 1RM, and Barbell Biceps Scott – maximum number of repetitions with 15kg load. Following parameters were obtained for the purpose of assessment of body composition: Body mass, Muscle mass, Body Fat, Body Water. Assessment of body composition was performed using bioelectric impedance TANITA BC-545n. Differences between the groups were assessed by ANOVA test of repeated measures. Upon taking insight into the results we may conclude that CR influences changes in body composition: Body mass (.000), Muscle mass (.039), Body Water (.010); effects to Body Fat are not statistically significant. In placebo group changes were noticed only in variable Body Water (.007). Effects to body strength were confirmed in all three variables: Bench Press (.050), Leg Press (.041), Barbell Biceps Scott (.003)., whereas no significant changes were observed in placebo group. CR is efficient dietary supplement for both professional and amateur athletes. **Citation.** *Bojan Bjelica , Borislav Cicović, Dalibor Stević, Rosario D'Onofrio , Tijana Perović , Radomir Pržulj , Nebojša Mitrović ; Effects of creatine monohydrate (CR) to muscle strength and body composition ; Ita. J. Sports Reh. Po.; 2020; 7; 3; 1624 -1637 ; ISSN 2385-1988 [online] IBSN 007-111-19 - 55; CGI J OAJI 0,101)]*

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INTRODUCTION

According to historical data, human population has always been seeking for ergogenous resources for improvement of physical performances. Evidence can be found in various records from Olympis Games in Greece which dated in 776 BC[23]. Use of supplements is widely spread at present time. In addition to regular dietary products for athletes and physically active people, many companies launched dietary supplements, often claiming that they would improve sport results. Supplements for improvement of exercising and sport performances are available in various forms such as: tablets, capsules, liquids and powders. Many products contain numerous ingredients in various combinations and quantities. Some of most frequently found are: amino acids, protein, creatine and caffeine[41.] There is a large number of available studies which provide evidence for influence of supplements to physical abilities[24,25,41,43,48,49,53] and changes in body composition[15,35,37,58.] CR is introduced through nutrition and is most frequently found in red meat and fish. Deposition of taken CR is 98% inside muscles while the rest of it is stored in brain, heart and other organs and excess is excreted through kidneys in form of creatinine[9.] CR is one of most widely used supplements for improving the effects of exercising and sport performances[37.] It helps formation of ATP and delivers energy into muscles, especially after short-term activity[56.] CR may improve muscle performance in four manners: by increase of phosphocreatine cells used for generation of ATP in the beginning of intensive exercising, by accelerating synthesis of

phosphocreatine after exercising again,by depression of degradation of adenine nucleotides and accumulation of lactates and/or improving the deposition of glycogen inside skeletal muscles[56.] Oral consumption of CR increases creatinine and PCR (Polymerase Chain Reaction) content of human skeletal muscles.[13,21,22,29,58.] Typical protocol for starting the CR intake in adults, regardless of their body size or gender, consists of the "loading" phase in course of 5 to 7 days when 20 g/day of CR are consumed in four portions of 5 g, followed by maintenance phase with 3–5 g/day[10.] Influence of CR to strength and changes in body composition was examined in other papers as well[30,45.] Considering the fact that strength is one of very significant motor factor, it has been defined many times. Maximum strength is maximal ability of muscle or group of muscles to create force. It is often measured by one repetition maximum (1RM), which is operationally defined as the heaviest load that can be moved over a specific range of motion, one time and with correct performance[50. 32]studied the effects of CR (5g/day) to strength and body composition. The research was conducted on sample of 19 healthy recreational male bodybuilders aged 23.1±2.9. Participants trained five days a week for four weeks. In addition to body composition, 1RM bench press and leg press tests (3 repetitions) were applied as well. Significant differences were observed in enhancement of muscle mass; fat mass and body weight did not reach significance. Strength was increased in all the applied variables. Similar results were obtained by[12.] CR consumption before and after training results in increase in lean body mass, muscle fibers and muscle strength. Similar results were obtained in other available research[5,27,57,61.] Aim of the research is to examine the effect of CR to muscle strength and body composition.

RESEARCH METODOLOGY

Sample

Sample for this research consisted of 14 participants divided into two sub-samples: N=6 participants who consumed CR, average weight 86.9 kg and height 182.6 cm, average BMI=26.2; N=8 participants – placebo group, average weight 84.3kg and height 183.4 cm with average BMI=25.1. Age of the participants was 24±6 months in span 22–28. All the participants were advanced recreational body builders with active participation of 4 months in training process (3–5 times a week). In the course of training participants were taking no supplements or prohibited substances (anabolic steroids). All the participants volunteered to take part in the research.

Measuring instruments

Initial tests were performed two days prior to the experimental protocol (EP). At 8AM all the participants undertook the test of body composition after which the test of strength was performed individually. Body composition was tested using bioelectric impedance TANITA, model BC-545n, Japan. The following parameters were selected for body composition: Body mass (kg), Muscle mass (kg), Body Fat (%), Water (%), in line with the standard protocol[44.] Strength was assessed using three tests: Bench Press (1RM), Leg Press (1RM) and Barbell Biceps Scott, maximum number of repetitions with15kg load (total weight

bar included). Prior to the strength test all the participants warmed-up all the muscle regions for 10 minutes and they did test tryout with pyramidal load increase (3-4 attempts) until maximum was established (1RM).

Experimental protocol

Total EP duration was 8 weeks (32 trainings), 4 x 90min. – Mon/Tue/Thu/Fri – Wed/Sat/Sun = rest time. Prior to each training all the subject performed individual warm-up of all muscle regions in duration of 8 – 10 min. Trainings had binary structure, consisting of one larger and one smaller muscle partition. Each of the exercises was performed 8 – 10 repetitions in 5 series. Breaks lasted for around 90s, and break between exercises around 3 minutes. In case of exercises for abdominal region exercises were performed in intervals of 40 – 60s with brakes of 60s in between. Experimental procedure was performed in Fitness Centre "Sparta" in Pale. Trainings started at 16:00. All five weeks of EP duration identical scheme was followed[32]:

- **Monday *(Chest +Triceps).*** *Chest* – (subject performed three of these) flat bench press, incline bench press, cable cross-overs, pec deck, flat bench flies, decline bench press; *Triceps* – (subject performed two of these) – triceps pushdowns, dips, French press.
- **Tuesday *(Back + Biceps).*** *Back* - (subject performed four of these) – Wide grip lat pulldown, narrow grip lat. pulldown, chin ups, cable rows, dumbbell rows, dumbbell flies; *Biceps* – (subject performed three of these) – standing barbell curls, standing EZ bar curl, concentration curls, preacher curls, hammer curls;
- **Thursday *(Legs + Shoulders).*** *Legs* – (subject performed five of these) – Back squats, Smith machine squats, Leg Press, Lunges, Leg curls, Leg extensions, calf raise (seated or standing), Stiff-legged deadlift. *Shoulders* – (subject performed 3 of these) – upright row, machine military press, dumbbell overhead presses, lateral dumbbell raises, shoulder shrugs.
- **Friday *(Cardio + Abdominal Muscles).*** *Cardio* – (Running on a treadmill 10 min.). *Abdominal Muscles* – (V-crunch, Bicycle Crunch, Russian twist, Plank, Leg raise, Incline sit-ups).

Supplementation

At the start of the EP, CR (Olimp Nutrition, PL) was consumed in the following order: First 7 days participants consumed 20g of CR with addition of dextrose (DEX). Dosage was divided into 4 equal parts (4x5g of CR). Each dose of CR was consumed with 20g DEX and solution was prepared with 500ml of liquid (water). After that phase each participant continued to take 5g CR + 20g DEX until the end of experimental protocol. Other participants were placebo group and they consumed only DEX solution without the CR. It is important to mention that CR was consumed every day, on training days and rest days as well.

Data processing

Data was obtained using the statistical data-processing package SPSS 20. Basic statistical parameters were presented for both groups of participants (CR and Placebo), and differences between the groups were assessed using the ANOVA test of repeated measures. All the results were presented as mean values.

RESULTS AND DISCUSSION

Parameters of body composition are presented in Table 1 for both groups of participants (CR and Placebo) at initial and final measuring. In accordance with the presented results and mean values it is observed that all four variables changed for CR group: Body mass (+3.4 kg), Muscle mass (+3.7 kg), Water (+1.3 %), Body fat (-0.6 %).

Table 1. Pre-test and post-test body composition is presented for CM and Placebo (means).

	CR			Placebo	
	Pre-test	**Post-test**		**Pre-test**	**Post-test**
Body mass (kg)	86.9	90.3		84.3	85.1
Muscle mass (kg)	69.6	73.3		69.1	71.2
Body fat (%)	14.7	14.1		14.0	13.9
Water (%)	61.4	62.7		61.4	62.8

Significance of differences is at borderline .05. Statistically significant differences were confirmed in three variables: Body mass (.000), Muscle mass (.039), Water (.010). In variable *Body fat* there were no statistically significant differences (.226). in Placebo group differences are at relatively lower level but can be noticed. Body mass (+0.8 kg), Muscle mass (+2.1 kg), Water (+1.4%), Body fat (-0.1 %). Statistically significant differences were observed only in variable *Water* (%) at level .007. Results are presented graphically in Figure 1.

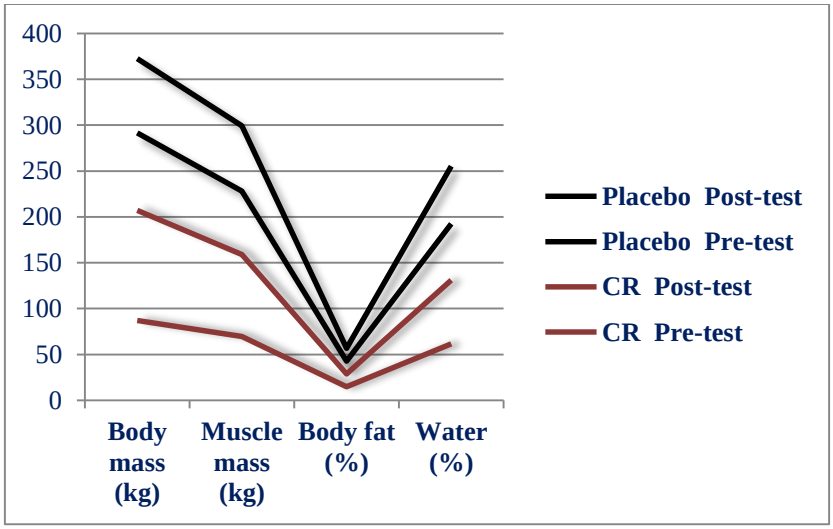

Figure 1.

Many studies where the effects of CR were examined confirmed that body mass increases after consuming the product for some amount of time[15,20,34,38,46,54,60]. Contribution to the increase is certainly possible due to total body water. Research has confirmed that aging causes changes in body composition and reduced water levels in the human organism[52]. It should be kept in mind that human body consists of 50–70% of water[55]. In our research, water parameters were higher for both CR and Placebo group, which was caused by physical effort due to applied training regime. Although the number of trials where water levels were examined is not high, all of the available data suggests that training on platform of aerobic exercising or training with extra load leads to increase of body water levels[11,14,17,28,51]. Muscle mass, being a constituent of total mass was significantly increased in CR group. It was established by some authors that total mass increases by 0.7–1.6 kg after short-term consummation of CR in combination with exercising with load[4,15,19,59]. [40]established significant increase of body mass of 0.84 kg in CR group versus placebo group 5 days after supplementation. It is important to emphasize that no changes were observed in body fat percentage in neither of groups which is a confirmation of the fact that use of CR contributes increase of pure muscle mass and a percentage of water. Such facts are supported by other research[1,18,19,33,39].

Values of the applied tests for strength assessment are presented in Table 2 for both groups of participants at initial and final measuring. Observing the data and mean values we may conclude that in CR group there are significant differences in all three variables: Bench Press (+10.7kg), Leg Press (+12.0 kg), Barbell Biceps Scott (+5 repetition). Using the statistical procedure, statistical significance is observed in all three tests at .05 level: Bench Press (.050), Leg Press (.041), Barbell Biceps Scott (.003). In addition to the effect of CR to body composition, we may conclude that the influence of supplements to strength is pronounced. Improvement after eight weeks was in line with hypothetical expectations.

Table 2. Pre-test and post-test strength is presented for CR and Placebo (means).

	CR			Placebo	
	Pre-test	**Post-test**		**Pre-test**	**Post-test**
Bench Press (1RM)	94.8	105.5		95.7	100.4
Leg Press (1RM)	92.7	104.7		93.6	97.3
Barbell Biceps Scott (rep.)	11.5	16.5		11.6	14.3

Increase of strength was also observed in placebo group although not a statistically significant level: Bench Press (+4.7 kg) at the statistical level .389; Leg Press (+3.7 kg) at the statistical level .377; Barbell Biceps Scott (+2.7) at the statistical level .149. Since these participants used no supplementation, increase of strength is present but much slower in

comparison to the CR group. More comprehensive overview of parameters is presented in the graph (Figure 2).

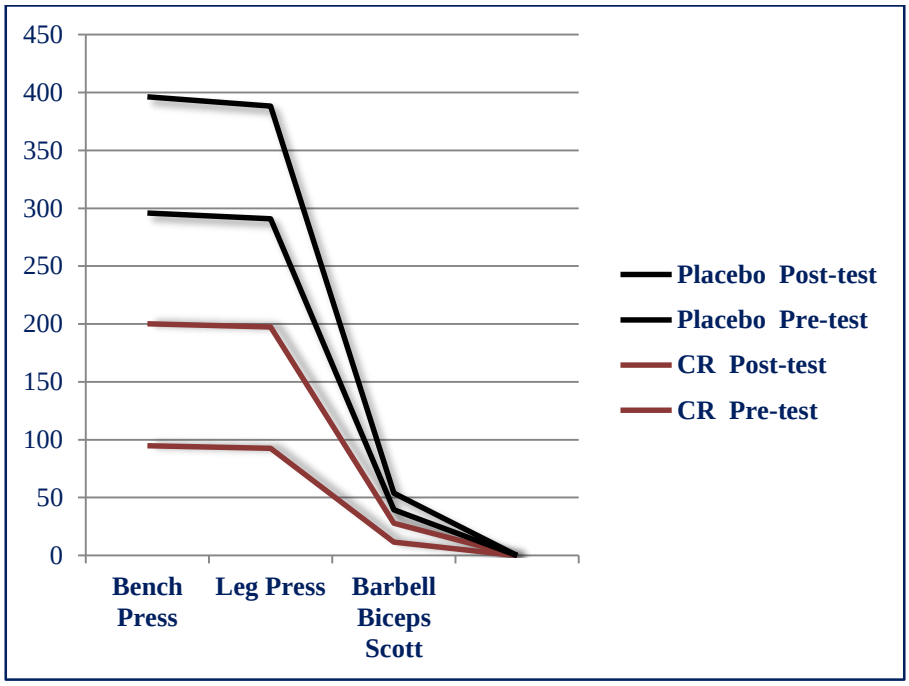

Figure 2

Muscle strength is the connection between generated force and velocity of[2.] It is indisputable that CR influences strength. Adequately programmed training is also one of the relevant factors in realisation of envisioned goals. Creatine also helps muscle regeneration after training which increases the possibility to make progress and perform the following training. A number of studies confirms the obtained results and positive influence of CR in comparison to the Placebo group[3,8,15,61] as well as the influence of CR to increase in strength and muscle mass[5,6,7,10,31,36. 1]in 2001 noticed increase of maximum strength (1RM) for ~13 kg in participants who consumed CR supplements and had trainings with load versus participants who were taking no supplementation. Improvements were noticed in particular exercises bench press by ~9.5 kg and leg press by ~33 kg. Group which performed training with load and creatine supplementation increased maximum strength by ~64 kg. [26](2002) noticed increase in maximum strength in bench press by ~4 kg in supplemented group (versus placebo group with no improvement) and increase in maximum strength in performing Leg Press by~33kg, versus ~13 kg in placebo group. Results of this research suggest that oral consummation of CR in combination with adequately performed training regime can be effective instrument for improvement of physical performances. However, it is necessary to perform additional trials and establish influence of CR in more detail.

CONCLUSION

Research results suggest that the effects of CR are positive to body composition and increase in body mass with no changes to body fat. Oral intake of this supplement has pronouncedly positive effect to increase and development of muscle strength, which was also validated by results of many studies performed on this subject matter. This research is just a minor contribution to resolving the matter of influence of supplementation to body structure and physical performances. It would be interesting to establish the influence of CR to changes in body structure without the component of training or the effects of increased/reduced CR intake in longer time period and subsequent changes in the bloodstream.

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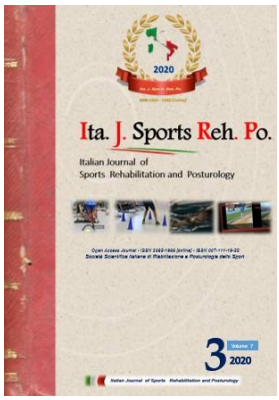

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