Effects of Creatine Supplementation on Motor Performance in Female Futsal Players

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ABSTRACT

The purpose of this study was to determine the effects of 15-day creatine supplementation on motor performance (20 m. sprint, squat jump, 30 s. repetitive vertical jumping, Wingate anaerobic power and capacity test, hand grip strength and back strength) of female soccer players. 28 female futsal players (age: 21,17±1,27 years) volunteered to participate in this investigation. Participants were randomly assigned to either creatine group (CR) or placebo group (PG). The Creatine group (CR) received creatine monohydrate supplementation for 15 days with a dose of 20 g for the first 5 days and 5 g for the following 10 days. Maltodextrine was given in the same amount to the placebo group (PG). Significant differences were found for 20 m. sprint, squat jump, 30 s. repetitive vertical jumping, Wingate anaerobic power and capacity test results ($p<0,05$), but no significant performance changes were found for right and left hand grip strength and back strength results after the creatine supplementation. No significant changes in the placebo group were observed in all performance tests following the 15 days experiment.

Keywords: *Creatine supplementation, exercise performance, futsal players, female athletes*

INTRODUCTION

Futsal is an indoor sport played in two periods of 20 min, including one goalkeeper and four outfield players in each team (Milanez et al., 2011). Physical demands of the futsal match can be very high (Barnes et al., 2007). Futsal played at the professional level is a high-intensity exercise heavily taxing the aerobic and anaerobic pathways (Castagna et al., 2006).

ATP (adenosine triphosphate) and PCr (phosphocreatine) are the primary sources of energy for high-intensity exercise (Balsom et al., 1993; Casey et al., 1996; Brooks et al., 1999; Manchado et al., 2008). Firstly, muscle contraction is fuelled by free adenosine-tri-phosphate (ATP) as the immediate energy source (Brooks et al., 1999). During anaerobic activity, the muscles first use the available ATP stores which are hydrolyzed during the process with the production of ADP, inorganic phosphate and hydrogen ions (Herda et al., 2009). ATP stores in muscle cells are limited and will deplete in 1 to 2 seconds unless restored (Sharma, 2010). PCr is a metabolite that supplies a reserve of energy used to regenerate ATP as a result of muscle contraction (Brooks et al., 1999; Kang, 2008) and plays a central role in the maintenance of power output during high intensity exercise (Rossiter et al., 1996).

Creatine is endogenously synthesized in the liver and naturally ingested through omnivorous diets such as meat (Schoch et al., 2006). It is transported via the circulatory system to the muscle cells. Creatine, when phosphorilated to form creatine phosphate (CrP) provides a source of high energy phosphate for the regeneration of adenosine triphosphate (ATP) during high intensity exercise (Burke et al., 2003). Creatine is synthesized from three amino acids, arginine, glycine and methionine, with the majority stored in skeletal muscle. Creatine monohydrate is the most widely used supplements form for improving athletic performance (Bemben and Lamont, 2005). Researchers have studied many different creatine loading programs, with the most common programme involving an initial loading phase of 20

g/day for 5–7 days, followed by a maintenance phase of 3–5 g/day for differing periods of time (Greenhaff et al, 1994; Hultman et al., 1996; Balsom and Sjödin, 1995).

MATERIAL AND METHODS

Participants: Twenty-eight female futsal players (age: 21,17 ± 1,27 years, body mass: 57,14 ± 6,57 kg, body height: 166,33 ± 6,09 cm) volunteered to participate in this investigation. Subjects were informed about the study objective and signed an informed consent form. Before the data were collected participants were familiarized with test procedures.

Measurement and Procedure: A randomized, double-blind, placebo-controlled study design was carried out. The subjects were randomly divided into two groups: Creatine Group (n=14) and Placebo Group (n=14). The Creatine group (CR) received creatine monohydrate supplementation four times per day (after breakfast, lunch, dinner and before bedtime) for 15 days with a dose of 4 X 5 g for the first 5 days and 5 g for the following 10 days. Maltodextrine was given in the same amount to the placebo group (PG). Subjects were instructed to consume their supplement dissolved in a 200 ml. of fruit juice. Performance of the tested subjects was evaluated before and after the supplementation period. Each subject visited the laboratory 4 times. The first visit consisted of grip strength, back strength, squat jump and 30 s repetitive vertical jumping evaluations. The second visit performed 4 hours later consisted of the 20 m sprint and the 30 s Wingate test. After the 15 days of supplementation, the testing procedures were repeated in the same order.

Grip Strength: The grip strength of both right and left hands was measured using a digital hand dynamometer (TKK 5401, Takei Scientific Instruments, Japan) in a standing position with the shoulder adducted and elbow in full extension. The subjects were asked to squeeze the dynamometer with as much force as possible with both dominant and non-dominant hands. The maximum values obtained during the three trials from each hand were used for further statistical analysis.

Back Strength: Isometric back strength of the subjects was measured with a digital back dynamometer (TKK 5402, Takei Scientific Instruments, Japan). Back strength was measured with the subjects standing in a slightly forward-bent position. Three attempts were made by all subjects with the best score registered.

20 meter Sprint: The 20 meter sprint was measured using an electronic timing system (Newtest Powertimer, Finland) following a 10 min warm-up. Subjects were required to run between markers placed 20 m apart in a sports hall. The athletes were asked to perform two maximum 20 m sprints with a 5 min passive recovery between the attempts. The better performance obtained during the two trials was used for statistical analysis.

Jumping Measurements: The squat and 30 s repetitive vertical jumping tests were performed on a force platform (Newtest Powertimer, Finland). The squat jump started from a half-squat position with a knee angle of 90^{o}. Subjects were asked to jump as high as possible. The jump was repeated two times, and the better performance was recorded.

Wingate Test: Anaerobic power and capacity output were measured by the 30 s Wingate test (Monark 894 E Peak Bike, Sweden). Prior to the Wingate test a 5 min warm-up was performed at a standardized workload 1 kg of resistance at 60-70 RPM. Seat and handlebar adjustment was made for each subject. The test was started after the external resistance was adjusted to 7,5 % of each subject's body mass. Subjects were asked to reach a maximal pace of unloaded sprinting as fast as possible. When the pedal speed reached 150 rev / min, the weight basket automatically falled down and the test was started. The subjects were instructed to pedal as fast as possible from the onset of the test. The athletes were encouraged verbally during the test to maintain a high frequency. The following variables were registered from the Wingate test: Absolute Anaerobic Power (Wt), Absolute Anaerobic Capacity (Wt), Relative Anaerobic Power (Wt/kg) and Relative Anaerobic Capacity (Wt/kg).

Statistical Analyses: Descriptive statistics for all variables were expressed as mean ± SD. Paired Samples T test was used to determine whether there is a significant performance differences in initial and post creatine supplementation conditions. One way ANOVA was used to determine whether there are significant differences between creatine and control groups before and after the supplementation periods. Statistical analysis of the measurements was performed by using SPSS 17 for Windows and the statistical significance was set at $p<0.05$.

RESULTS

The mean age, body height and body mass of the female futsal players were 21,17 ± 1,27 years, 166,33 ± 6,09 cm., 57,14 ± 6,57 kg., respectively.

Exercise performance results of the futsal players before and after the creatine ingestion are presented in Table 1.

Table 1. Pre and post experimental values of physical fitness test after the creatine supplementation

Varibles		Pretest (Mean±SD)	Posttest (Mean±SD)	t	*F* (Group)
20 m sprint (s)	Creatine Group (CP)	3,43±0,19	3,22±0,15¥,¥¥	4,47*	17,317**
	Placebo Group (PG)	3,59±0,16	3,61±0,24	-0,57	
Absolute wingate anaerobic power (Wt)	Creatine Group (CP)	513,43±55,44#	536,06±68,89¥,¥¥	-2,85*	11,503**
	Placebo Group (PG)	448,47±43,50	457,44±60,13	-1,27	
Relative wingate anaerobic power (Wt/kg)	Creatine Group (CP)	8,65±0,98	9,04±1,27	-2,83*	2,35
	Placebo Group (PG)	8,24±0,63	8,38±0,79	-1,17	
Absolute wingate anaerobic capacity (Wt)	Creatine Group (CP)	372,48±35,45	386,90±40,80¥,¥¥	-2,86*	9,643**
	Placebo Group (PG)	332,30±40,40	331,18±50,19	-0,20	
Relative wingate anaerobic capacity (Wt/kg)	Creatine Group (CP)	6,28±0,68	6,51±0,67	-3,03*	1,519
	Placebo Group (PG)	6,11±0,68	6,06±0,70	-0,50	
Squat jumping power (Wt)	Creatine Group (CP)	1839,78±256,98	2599,35±317,98¥,¥¥	-6,78*	8,522**
	Placebo Group (PG)	1959,71±465,55	1830,28±385,66	1,09	
30 s repetitive vertical jumping power (Wt)	Creatine Group (CP)	977,65±301,59	1189,29±339,38	-2,36*	1,107
	Placebo Group (PG)	1295,25±452,40	1182,83±56,386	1,21	
Right hand grip strength (kg)	Creatine Group (CP)	30,67±4,11	30,09±3,52	0,81	0,798
	Placebo Group (PG)	28,57±4,92	28,30±4,91	0,45	
Left hand grip strength (kg)	Creatine Group (CP)	28,11±3,42	27,61±3,09	0,73	1,479
	Placebo Group (PG)	26,93±4,26	26,43±3,79	0,94	
Back strength (kg)	Creatine Group (CP)	101,78±16,09#,##	107,53±17,24¥,¥¥	-1,80	14,954**
	Placebo Group (PG)	80,02±17,11	82,32±17,77	-0,78	

P<0,05*- There was a significant difference between pretest and posttest values.

P<0,05**- There was a significant difference between Creatine Group and Placebo Group's values.

- There was a significant difference between Creatine Group and Placebo Group's pretest values.

- There a significant difference between Creatine Group's pretest values and Placebo Group's posttest values.

¥ - There a significant difference between Creatine Group's posttest values and Placebo Group's pretest values.

¥¥ - There was a significant difference between Creatine Group's posttest values and Placebo Group's posttest values.

Test results show that significant differences were found for 20 m. sprint, squat jump power, 30 s. repetitive vertical jumping power, relative Wingate anaerobic power, relative anaerobic capacity, absolute anaerobic power and absolute anaerobic capacity ($p<0,05$), but no significant performance changes were found for right and left hand grip strength and back strength results after the creatine supplementation (Table 1). No significant changes in the placebo group were observed in all performance tests following the 15 days experiment. The One-way ANOVA test indicated that there are significant differences in terms of absolute anaerobic power and back strength scores between creatine and control groups before the supplementation periods ($p<0,05$) (Table 1).

DISCUSSION AND CONCLUSION

Some activities as well as soccer, cross-country running and biking require high-intensity bursts of speed and power during the competition (Biwer et al., 2003). Due to its specific characteristic, futsal contain high intensity short-term movements. Several creatine supplementation studies have shown that oral ingestion of creatine monohydrate can enhance burst of speed sport performance (Pearson et al., 1999; Biwer et al., 2003). The aim of our study was to determine the effects of creatine supplementation on motor performance in female futsal players. The results of this study demonstrate that a 15-day creatine supplementation produced significant improvements in 20 m. sprint, squat jump, 30 s. repetitive vertical jumping, relative anaerobic power, relative anaerobic capacity, absolute anaerobic power and absolute anaerobic capacity. These results are consistent with similar studies that investigated the effects of short or long-term Cr supplementation. For instance, Kirksey et al. (1999) randomly assigned 36 male and female track and field athletes to either placebo or creatine groups to examine the effect of six weeks creatine supplementation on using 5 X 10-second maximum cycle sprints. After supplementation period; they found a significant improvement in cycle performance. Law et al. (2009) investigated the effects of 20 g of creatine loading with resistance training during a 5 day period. They found that there were significant differences in peak power and average power after the 5 days of supplementation. Herda et al. (2009) examined the effects of a moderate dose of creatine monohydrate (CM) and two smaller doses of polyethylene glycosylated (PEG) creatine on muscular strength, endurance, and power output during a 30-day supplementation period. After the 30-day creatine supplementation, they found significant increases in absolute average power, absolute mean power, relative average power and relative mean power evaluated by the Wingate test. In contrast to our study, Hoffman et al. (2005) examined the effects of 6-days of creatine monohydrate supplementation on repeated three 15 s Wingate tests, found no significant differences in peak and mean power. In this study, the authors used much lower dose of creatine (6 g of creatine monohydrate per day).

Previous investigations (Skare et al., 2001; Cox et al., 2002) have demonstrated increases in sprint performance after various doses and durations of creatine supplementation. Cox et al. (2002) investigated the effects of acute creatine supplementation on repeated 20 m sprint performance of elite female soccer players. After the initial testing session, subjects were assigned to either a creatine (5 g of Cr, 4 times per day for 6 days) or a placebo group. After the experiment, the Creatine group had better repeated sprint performance than the Placebo group. Skare et al. (2001) examined the effects of 20 gr of creatine and glucose supplementation on 100 m sprint performance of elite male sprinters during 5 days of supplementation. After the 5-day creatine supplementation, significant improvement in sprint performance was observed in creatine groups.

Previous investigations have demonstrated increases in squat jumping and repetitive vertical jumping performance (Haff et al., 2000; Ostojic, 2004; Stone et al., 1999; Herda et al., 2009) after creatine supplementation. Haff et al. (2000) investigated the effect of 6 weeks of oral creatine monohydrate ingestion accompanied by a periodized weight-training program on jumping performance. 16 male and 20 female athletes were randomly assigned to either placebo or creatine groups. The consequences of their study highlighted that creatine supplementation can fairly raise counter movement jumping performance in track athletes. Ostojic (2005) examined the effects of acute creatine-monohydrate supplementation on soccer-specific performance in youth athletes. The subjects were divided into a creatine-monohydrate (3 x 10 g/d) group or a placebo group for 7 days. After the supplementation protocol, a significant improvement in vertical jump height was observed in the creatine groups. Stone et al. (1999) demonstrated the efficacy of two dietary supplements on measures of body mass, body composition, and performance in 42 American football players. After the 5 weeks supplementation period, subjects that ingested creatine showed significantly greater increases for static vertical jump power output. Herda et al., (2009) found a significant improvement in countermovement vertical jump after the 30-day supplementation period.

We demonstrated that creatine supplementation did not affect hand grip (right and left hand) and back strength results. Our results are consistent with similar studies (Mihic at al., 2000; Gotshalk at al., 2008; Urbanski at al., 1999) that investigated the effects of Cr supplementation on isometric hand grip strength. In our study, a lack of meaningful differences in hand grip and back strength values of the futsal players could be due to the more intense use of the muscles of the upper extremities in comparison to the upper extremities during a 15-day creatine supplementation. Indeed, the strength of the back muscles and the fingers may be insignificant for performance in futsal. Patlar et al.

(2010) stated that the use of lower extremities more effectively in soccer may not provide a significant increase in back strength. Strength and power in leg muscles are important factors for soccer players (Bangsbo et al., 1991). Maximal leg strength is of great importance to soccer abilities such as jumping, sprinting, stopping and changing direction. Football players use numerous explosive bursts such as kicking, tackling, jumping, turning, sprinting, and changing pace during a football game (Bangsbo et al., 2006). Many studies on the soccer kick emphasized the importance of maximum power of lower limb muscle and coordination between agonist and (vastus lateralis and medialis, rectus femoris, tibialis anterior and m. iliopsoas) and antagonist muscle groups (gluteus maximus, biceps femoris and semitendinosus) during the kick (De Proft et al., 1988; Isokawa and Lees, 1988; Lees and Nolan, 1998; Manolopoulos et al., 2006). Therefore, the use of lower extremities has a positive effect on speed, acceleration and soccer-specific skills (Strølen et al., 2005).

As a result of this study, we can be expressed that a dose of 20 g for the first 5 days and 5 g for the following 10 days creatine monohydrate supplementation has positive effects on motor activities such as speed, agility and explosive strength characteristics of the female futsal players.

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