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Changes of physiological demands and skill performance of soccer players following creatine supplementation

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KEYWORDS

Creatine supplementation, Skill, Physiological demands, Soccer players

A B S T R A C T

The purpose of this study was to investigate the effect of creatine supplementation (CrS) on physiological demands and skill performance of soccer players. Twenty male soccer players (age: 22.6 ± 1.1 years) participated in a placebo (Plc, n=10)/creatine (Cr, n=10), double-blind study conducted over 7–day period. The Cr group ingested 20 g (4 × 5 g) creatine monohydrate per day and Plc group ingested the same dosage of a glucose polymer. Skill performance and physiological demands were measured before and after the CrS. The results showed that CrS had significant effect on sprint performance, dribbling, agility with and without ball. Furthermore, heart rate, systolic and diastolic blood pressure decreased after a week CrS. In summary, CrS improves physiological demands and skill performance in soccer players.

Introduction

According to reports, about 95 percent of body creatine is stored in the muscles with about 60 to 70 percent phosphocreatine [1]. Several studies have shown that short-term CrS may enhance the athlete’s capacity to perform repeated muscular actions or bouts of high-intensity exercise and maintain power output as well as delay onset of muscular fatigue, in addition to promoting faster recovery between bouts of intense exercise [2,3]. Creatine plays an important role in energy metabolism and produce energy for short duration exercise.

Studies have shown that after consumption of creatine for 2 to 7 days in a dose of 20 g daily, significant increase (approximately 10 to 20 percent) of the total increase pool and phosphocreatine concentration (approximately 20 to 40 percent) took place.

Soccer is a high intensity, intermittent sport in which accelerations and short sprints are performed at maximal or almost maximal intensity, interspersed (followed / pursuit) by brief recovery periods (activities of low intensity or pauses), during a relatively long period of time (almost more than 90 minutes) [3]. High-intensity resistance exercise may benefit from Cr loading because energy-rich phosphates significantly contribute to the energy yield during resistance tasks [4].

Accordingly, we believe that in order to improve their soccer performance, players must arrange specific soccer physiological demands and skill performance, such as sprint, agility and dribbling. Although large amount of articles analyzing and studying the anthropometry of soccer players, the parameters of soccer, its physiological demands and the fitness level of the teams, there is a little data concerning the possible effects of oral creatine monohydrate supplementation on specific performance in sport such as soccer. Cr monohydrate is the most widely used supplements form for improving athletic performance [5], but the effect of this supplementation on physiological demands and skill performance of soccer players is not clear. Lack of studies regarding the effect of CrS on physiological demands and skill performance in soccer players and little attention to the effect of CrS in these parameters led to the current study investigating the effect of CrS on physiological demands and skill performance in soccer players.

Methods

Participants: Twenty male soccer players (age: 22.6 ± 1.1 years) volunteered to participate in this investigation. Subjects were informed of the study objectives and signed an informed consent form. Prior to data collection, 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: Cr group (n=10) and Plc group (n=10). The Cr group received CrS four times per day (after breakfast, lunch, dinner and before bedtime) for 7 days with a dose of 4 × 5 g for all of the days. Plc group received the same dosage of a glucose polymer. Both supplements had similar taste, texture and appearance and were placed in generic packets to ensure double-blind administration. Participants followed their normal diet but eliminated caffeine and caffeine-containing foods throughout the experimental period to minimize the possible inhibitory effects of caffeine on the ergogenic effect of Cr. At the end of the study all participants gave verbal assurance that they had complied with these instructions. 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 sprint test, agility with and without ball and dribbling evaluations. The second visit performed one day later, consisted of the Yo-Yo Intermittent Recovery test. After the 7 days of supplementation, the testing procedures were repeated in the same order.

Agility without ball: The Slalom test was performed to evaluate the agility [6]. All the subjects started with both feet behind starting point. Six cones were located 2 m apart, the first cone 1 m away from the starting line. Every player stood still facing the starting line, with his feet apart and the cone between his legs. He started after the signal and ran from point to point. The player at second point had to be passed on his right-hand side. The player continued to run as fast as possible constantly, changing the direction from right to left until he reached. The player stood at the last point. Afterward, the player turned 180°, and kept on running based on the Slalom style to the starting line [6].

Agility with ball: The Slalom test with ball was performed to evaluate the agility with ball. This test is structurally the same as the Slalom test, but the only difference was utilizing ball in this one [6].

Sprint: To measure the speed, repetitive sprinting test was used. Thus subjects performed six distances of 15 meters sprint that were interspersed by 30 seconds of recovery. The recovery was active rest (walking slowly) [7].

Dribbling: Dribble test consists of five cones on a line with 1 m distance between them. The starting point was 1 meter far from the first cone. Each subject stood at the start point while holding the ball under his dominant foot. Hearing the whistle, he began the dribble test with maximum speed. As soon as passing the last cone, he returned to the starting point with his maximum speed. Time of performance was recorded by the timer [7].

Physiological demands: VO_{2max} was measured by Yo-Yo Intermittent Recovery test. Heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) also evaluated before, immediately, two and four min after the Yo-Yo Intermittent Recovery test. Subjects started running back and forth a 20-m course and must touch the 20-m line. The initial speed was 8.5 km/hr. The speed got progressively faster (0.5 km/hr every minute), in accordance with a pace dictated by a sound signal on an audiotape. Several shuttle runs made up each stage. The subjects were instructed to keep pace with the signal for as long as possible. When the subjects could no longer follow the pace, the last stage announced was used to predict the maximal oxygen uptake using the equation of Leger et al. [8]. The equation:

$$Y = -27.4 + 6.0X, \text{ Where } Y = VO_{2\,max} \text{ (ml/kg/min)}$$

$$X = \text{Maximal shuttle run speed (km/hr)}$$

Statistical analysis

Results were expressed as the mean ± SD and distributions of all variables were assessed for normality. Paired t-test was used to compute mean (± SD) changes among variables in control and concurrent training group pre and after the intervention. Differences among groups were assessed by using and independent t-test. The level of significance in all statistical analyses was set at $P \leq 0.05$. Data analyses were performed using SPSS software for windows (version 17, SPSS, Inc., Chicago, IL).

Results and Discussion

The changes of skill performance and VO_{2max} before and after the CrS in each group are presented in the Table 1. The results demonstrated that CrS had significant effect on these variables. As the shown in the Table 2, HR, SBP and DBP increased ($P<0.05$) after the Yo-Yo test before and after the supplementation in the both group and decreased ($P<0.05$) after two and four min after the test. For the HR no significant changes were observed before and after the supplementation in the both group, however, Cr lead to decrease the SBP and DBP ($P<0.05$).

The results showed that sprint performance and dribbling had significant changes in Cr group. Previous investigations have demonstrated increases in sprint performance after various doses and durations of CrS [9]. Cox et al. (2002) investigated the effects of acute CrS on repeated 20 m sprint performance of elite female soccer players.

Table.1 Skill performance and VO_{2max} (mean ± SD) of the subjects before and after the supplementation

	Pre (mean ± SD)	Post (mean ± SD)
Sprint (s)		
Cr (n=10)	4.7 ± 0.2	4.08 ± 0.08
Plc (n=10)	4.5 ± 0.2	4.4 ± 0.2
Agility without ball (s)		
Cr (n=10)	10.6 ± 0.4	10.0 ± 0.3
Plc (n=10)	10.19 ± 0.3	10.19 ± 0.2
Agility with ball (s)		
Cr (n=10)	12.5 ± 0.4	12.0 ± 0.2
Plc (n=10)	12.3 ± 0.2	12.3 ± 0.1
Dribbling (s)		
Cr (n=10)	15.2 ± 1.7	15.6 ± 1.0
Plc (n=10)	16.7 ± 1.2	16.9 ± 1.1
VO_{2max}		
Cr (n=10)	54.5 ± 3.7	55.9 ± 3.7
Plc (n=10)	56.4 ± 3.3	59.5 ± 0.8

Table.2 Changes of cardiovascular variables (mean ± SD) before and after the supplementation

	Baseline			
	Resting SBP (mmHg)	SBP immediately after the Yo-Yo test (mmHg)	SBP; 2 min after the Yo-Yo test (mmHg)	SBP; 4 min after the Yo-Yo test (mmHg)
Cr (n=10)	122.7 ± 6.1	149.1 ± 11.3*	133.6 ± 10.8*†	122.3 ± 9.9*†
Plc (n=10)	122.5 ± 6.7	147.5 ± 9.6*	130.5 ± 10.7*†	118.5 ± 7.7*†
	After the supplementation			
	Resting SBP (mmHg)	SBP immediately after the Yo-Yo test (mmHg)	SBP; 2 min after the Yo-Yo test (mmHg)	SBP; 4 min after the Yo-Yo test (mmHg)
Cr (n=10)	118.5 ± 2.5‡	145.5 ± 13.7*‡	133.3 ± 8.2*†	121.3 ± 5.4*†
Plc (n=10)	123.4 ± 3.8	146.5 ± 7.5*	130.6 ± 6.9*†	117.8 ± 6.1*†
	Baseline			
	Resting DBP (mmHg)	DBP immediately after the Yo-Yo test (mmHg)	DBP; 2 min after the Yo-Yo test (mmHg)	DBP; 4 min after the Yo-Yo test (mmHg)
Cr (n=10)	79.9 ± 3.5	84.9 ± 5.9*	78.3 ± 5.6*†	71.9 ± 5.4*†
Plc (n=10)	81.3 ± 2.7	98.1 ± 20.8*	84.9 ± 14.9*†	76.7 ± 9.6*†

	After the supplementation			
	Resting DBP (mmHg)	DBP immediately after the Yo-Yo test (mmHg)	DBP; 2 min after the Yo-Yo test (mmHg)	DBP; 4 min after the Yo-Yo test (mmHg)
Cr (n=10)	77.1 ± 2.3‡	86.9 ± 7.1*	83.2 ± 7.0*†	80.2 ± 4.8*†‡
Plc (n=10)	81.0 ± 1.6	85.5 ± 5.7*	80.3 ± 4.7*†	74.9 ± 4.3*†
	Baseline			
	Resting HR ($b.min^{-1}$)	HR immediately after the Yo-Yo test ($b.min^{-1}$)	HR; 2 min after the Yo-Yo test ($b.min^{-1}$)	HR; 4 min after the Yo-Yo test ($b.min^{-1}$)
Cr (n=10)	73.1 ± 2.9	136.3 ± 12.9*	120.2 ± 11.1*†	107.6 ± 10.1*†
Plc (n=10)	71.4 ± 3.3	132.6 ± 12.9*	113.6 ± 12.5*†	101.7 ± 10.7*†
	After the supplementation			
	Resting HR ($b.min^{-1}$)	HR immediately after the Yo-Yo test ($b.min^{-1}$)	HR; 2 min after the Yo-Yo test ($b.min^{-1}$)	HR; 4 min after the Yo-Yo test ($b.min^{-1}$)
Cr (n=10)	68.9 ± 2.3	135.0 ± 16.52*	120.6 ± 8.0*†	109.4 ± 8.9*†
Plc (n=10)	71.4 ± 3.5	123.8 ± 14.1*	107.1 ± 11.1*†	95.3 ± 10.2*†

* Significant differences with Before the Yo-Yo test (P<0.05)
† Significant differences with immediately after the Yo-Yo test (P<0.05)
‡ Significant differences before and after the CrS at the same time (P<0.05)

After the initial testing session, subjects were assigned to either a Cr (5 g of Cr, 4 times per day for 6 days) or a Plc group. After the experiment, the Cr group had better repeated sprint performance than the Plc group [9]. Skare et al. (2001) examined the effects of 20 gr of Cr and glucose supplementation on 100 m sprint performance of elite male sprinters during 5 days of supplementation. After the 5-day CrS, significant improvement in sprint performance was observed in Cr groups [10]. Mohebbi et al. (2012) also indicated that the time of sprint running test and dribbling decreased significantly in the creatine group after a week CrS in young soccer players [11]. The researchers noted that increased speed of the subjects after CrS that might be due to increased muscle phosphocreatine resynthesis in the rest between activities, as H^+ buffer and increase production of ATP [11-12]. These discrepant results may be attributed to differences in timing in blood sampling, variation in the exercise protocols and differences in subject populations.

Our results also demonstrated that CrS had significant effects on agility with or without ball. Previously Cox et al. (2002) showed that agility performance improved after short-term CrS in elite female soccer players [13-14]. They noted that increased agility of the subjects after CrS that might be due to increased of the speed. As the our result showed, sprint performance had not significant changes after CrS thus it seems that lack of effect of CrS on agility in the present study might be due to the absence of reductions in speed performance. In addition, results indicated that CrS had significant effect on VO_{2max}. The finding that CrS influences VO_{2max} is in agreement with previous literature [15]. At the end, the results indicated that although CrS had no significant effect on HR, but it could decrease SBP and DBP in soccer players. Further evidence to suggest that cardiopulmonary function during exercise was unaffected by CrS was provided by the similarity in heart rate and net oxygen uptake responses before and after supplementation.

In support of this conclusion, most previous studies that evaluate similar outcomes have failed to identify any effect of CrS on aerobic capacity in healthy [15] and diseased populations [16]. Murphy et al. (2013) noted that blood pressure had not significant changes after a week CrS healthy males [17]. Cr may lead to cardiac hypertrophy, increase of septum, and decrease of sympathetic tone and these mechanisms may play a part in decreasing blood pressure, however additional researches are needed to examine these mechanisms.

References

1. Barbero Álvarez, J.C., V. Soto and J. Granda, 2003. Temporary analysis during match play in soccer (indoor soccer) with photogrammetric system. Book of abstracts: Science and Football, 5: 266.
2. Barbero Álvarez, J.C., V. Soto and J. Granda, 2004. Análisis de la frecuencia cardiaca durante la competición en jugadores profesionales de Fútbol Sala. Apunts De Educación Física, 77: 71-78.
3. Barbero Álvarez, J.C., V. Soto and J. Granda, 2004b. Effort profiling during indoor soccer competition. Journal of Sports Sciences, 22: 500-501.
4. Harmancı, H, A. Kalkavan, M.B. Karavelioğlu, and A. Şentürk. 2013.

Effects of Creatine Supplementation on Motor Performance in Female Soccer Players. The Online Journal of Recreation and Sport. 2:1-7.
5. Bemben MG, Lamont HS. 2005. Creatine supplementation and exercise performance. Sports Medicine, 35: 107-125.
6. Milanović Z, G. Sporiš, N. Trajković, and F. Fiorentini. 2011. Differences in agility performance between soccer and soccer players. Sport Science, 2: 55-59.
7. Ostojic, S.M. 2004. Creatine supplementation in young soccer players. International Journal of Sport Nutrition and Exercise Metabolism, 14: 95-103.
8. Leger L, Gadoury C. 1989. Validity of the 20-m shuttle run test with 1 minute Stages to predict VO2 Max in Adults. Canadian J Sports Sci, 14: 21-6.
9. Cox G, I. Mujika, D. Tumilty, L. Burke. 2002. Acute creatine supplementation and performance during a field test simulating match play in elite female soccer players. International Journal of Sport Nutrition and Exercise Metabolism, 12: 33-46.
10. Skare, O.C., O. Skadberg, A.R. Wisnes. 2001. Creatine supplementation improves sprint performance in male sprinters. Scandinavian Journal of Medicine and Science in Sports, 11: 96-102.
11. Mohebbi H, N. Rahnama, M. Moghadassi and K. Ranjbar. 2012. Effect of Creatine Supplementation on Sprint and Skill Performance in Young Soccer Players, Middle-East Journal of Scientific Research, 12: 397-401.

12. Falah Mohammadi, Z., V.A. Dabidi Roushan and H. Soltani, 2007. The effect of creatine supplementation on blood lactate after an intermittent exercise protocol in trained taekwondo players. Olympic fall, 15: 45-53.
13. Kuethe, F., A. Krack, B.M. Richartz, and H.R. Figulla. 2006. Creatine supplementation improves muscle strength in patients with congestive heart failure. Pharmazie, 61:218–222.
14. Kilduff, L.P., E. Georgiades, N. James, R.H. Minnion, M. Mitchell, D. Kingsmore, et al. 2004. The effects of creatine supplementation on cardiovascular, metabolic and thermoregulatory responses during exercise in the heat in endurance-trained humans. International Journal of Sports Nutrition and Exercise Metabolism, 14:443–460.
15. Chwalbinska-Moneta J. 2003. Effect of creatine supplementation on aerobic performance and anaerobic capacity in elite rowers in the course of endurance training. International of Sports Nutrition and Exercise Metabolism, 13:173–183.
16. O'Reilly, D.S., R. Carter, E. Bell, J. Hinnie, and P.J. Galloway. 2003. Exercise to exhaustion in the second-wind phase of exercise in a case of McArdle's Disease with and without creatine supplementation. Scotland Medicine Journal, 48:46–48.
17. Murphy, A.J., M.L. Watsford, A.J. Coutts, and D.A.B. Richards. 2005. Effects of creatine supplementation on aerobic power and cardiovascular structure and function. Journal of Science and Medicine in Sport, 8: 305–313.