THE EFFECT OF ACUTE CREATINE SUPPLEMENTATION ON FATIGUE AND ANAEROBIC PERFORMANCE IN SOCCER PLAYERS

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Abstract The aim of this study is to investigate the effect of acute creatine monohydrate supplementation on fatigue and anaerobic performance. Thirty young soccer players participated in this study. Participants continued their training without taking any food supplements for 5 days, taking 0.3 g of milk dust per kg for 5 days and using 0.3 g creatine monohydrate per kg for 5 days. A total of 6 × 35 m sprint times were used in the fatigue index with a 10-second rest period between them. Single repeated sprint times of 35 m were examined as well. Statistically significant differences ($p < 0.05$) were found both fatigue index and single repeated 35 m sprint time after creatine supplementation. However there was not a statistically significant difference ($p > 0.05$) in Rast Test results. In soccer, it is known that there is a strong positive correlation between game performance and the number of repeated sprint numbers in a game. In conclusion, there was a statistically significant effect of 0.3 g of acute creatine loading per kg over 5 days on the single repeated sprints and fatigue index values. The creatine monohydrate can be used as an ergogenic aid for recovery periods between high-intensity exercises to affect performance.

Key words creatine, anaerobic performance, fatigue, soccer

Introductıon

In recent years, ergogenic supplements to increase performance and delay fatigue have become more common. The most commonly used ergogenic food supplement to increase performance is creatine monohydrate (Toktas, 2006). Anaerobic performance includes brief explosive exercises. The immediate need for such exercises is supplied from ATP-CP and anaerobic glucose. The total amount of energy that can be produced through such procedures comprises the anaerobic capacity (Kenney, Wilmore, Costill, 2012). In soccer, the anaerobic capacity is required for several movements such as starting quickly to run, running quickly, changing the direction quickly, jumping high to head the ball, and flinging the legs quickly to kick the ball (Sporis, Jukic, Ostojic, Milanovic, 2009).

The use of acute creatine significantly predicts not only the increase in body mass and muscular power (Becque, Lochmann, Melrose, 2000; Bemben, Bemben, Loftiss, Knehans, 2001; Eckerson, Stout, Moore, Stone, Nishimura, Tamura, 2004; Haff et al., 2000; Wilder, Deiuert, Hagerman, 2001) but also the increase in contractile protein synthesis (Willoghby, Rosene, 2001). The maximization of muscle creatine storage requires 20 gr/d^{-1} for 5 days (0.3 gr/kg^{-1}) and maintenance requires 2 g/d^{1} (0.03 g/kg^{-1}) (Glaister, Stone, Stewart, Hughes, Moir, 2004).

Since the 1990s, various studies have been conducted to examine the use of creatine, which is one of the ergogenic substances, to increase the performances of athletes (Ostojic, 2004). The results basically showed that the use of creatine monohydrate increased short-term intense anaerobic performance (The American College of Sports Medicine, 2000; Brenner, Rankin, Sebolt, 2000; Warber et al., 2002). The creatine phosphate (PCr) for muscles serve as a source of energy to refresh ATP during short exercises lasting less than 10 seconds (Glaister et al., 2004; Fox, Bowers, Foss, 1999; Powers, Arnold, Weltman, Perin, 2003). By ensuring an increase in muscle creatine and creatine phosphate through loading creatine, an improvement in energy sources and stimulation of muscle development was observed (Powers et al., 2003, Cox, Mujika, Tumilty, Burke, 2002).

Creatine is in monohydrate form and is an ergogenic supplement commonly used by athletes. The main reason for the performance-improving feature of creatine is that it increases the synthesis of creatine phosphate during recovery time after exercising, which is very useful at specific performance-based and high-intensity sports such as soccer, as it requires single or repeated sprint activities (Buford et al., 2007, Delecluse, Diels, Goris, 2003; Yquel, Arsac, Thiaudiere, 2002). However, there are also several studies indicating no positive effect of acute creatine use on anaerobic performance (Sewell Robinson, Greenhaff, 2008; Cooke, Barners, 1997).

The aim of this study is to investigate the effects of acute creatine monohydrate supplementation on fatigue and anaerobic performance parameters among young soccer players. It is expected that the breaks between the high-intensity short-term exercises will be shorter when acute creatine is used with the phosphate energy system (ATP-CP). Thus, it is also expected that performance losses will be lower in high-intensity exercises.

Methods

Study sample

30 young soccer players participated in this study. The participants and their parents were informed about the aim and potential risks of this study and then signed informed consent forms. Bioethical committee agreement for the research conduction was received from the department.

Data collection/tests and measurements

The participants' heights were measured in cm with the participants' heels attached, standing upright and without shoes. Their body weight and body fat rates were measured with tanita bc-418 and with 0.01 sensitive bio-impedance method when they were in bare feet.

The Rast Test was used to assess the anaerobic performance and fatigues levels. The total time and fatigue indexes recorded. Additionally, the standing long jump and 35 m sprint tests which were among the anaerobic performance indicators, were performed during these tests.

Study design

The pre-tests of the participants were completed and they continued their routine soccer training program during 5 days without taking any food supplement. On the 6th day all the test results were recorded (Rast[1], 35 m sprint[1] and long jump[1]). Beginning with the 7^{th} day, for the placebo condition, 0.3 gr/per kg powder milk was mixed with fruit juice and delivered to the participants until the 12^{th} day, with all the tests conducted again (Rast[2], 35 m sprint[2] and long jump[2]). Starting with the 13^{th} day, participants were placed in the creatine monohydrate condition and received creatine monohydrate. On the 18^{th} day, all the tests were repeated for the last time (Rast[3], 35 m sprint[3] and long jump[3]). Daily total use of powder milk or creatine was 0.3 per kilogram; they were packed in 3 doses equally and consumed 3 times a day by mixing it with fruit juice. The participants did not know which condition they were in during the study. The results were shown as mean and deviation. The paired samples t-test was used to determine the difference between pre and post-tests of groups. SPSS 10.0 statistical program and $p < 0.05$ significance level was used.

Figure 1 shows the study design.

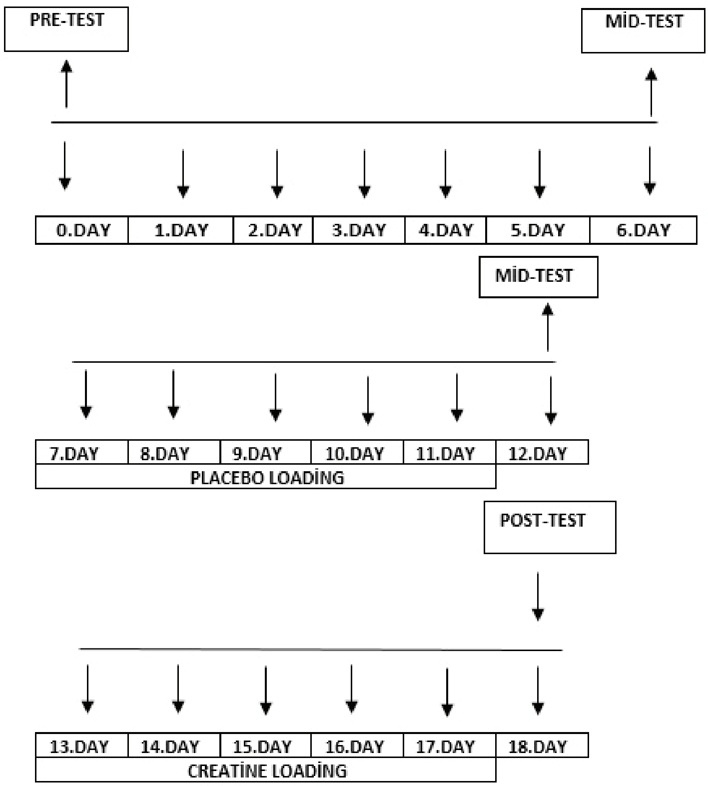

Figure 1. Study design

Results

As seen in Table 1, 30 soccer players participated in this study, with an age average of 16.3 ±0.73 years, with a body weight average of 63.9 ±6.20 kg, with a height average of 175 ±4.70 cm and with a body fat rate average of 13 ±3.04%.

Table 1. Lists the descriptive statistics about the participant soccer players

	N	Average	Sd.
Age (year)	30	16.3	0.73
Body Weight (kg)	30	63.9	6.20
Length (cm)	30	175	4.70
Body Fat (%)	30	13.0	3.04

The descriptive statistics related to soccer players' anaerobic performances

Considering that today's soccer game has gained speed, repeated sprints are a good indicator of performance. Table 2 and Table 3 present the Rast Test results used to assess the repeated sprint performances of the study participants, total sprint times and fatigues indexed.

Table 2. The total repeated sprint times (Rast)

The total repeated sprint times	N	Avg.	Sd.	Std. error	T test	
$Rast^1 – Rast^2$	30	32.541 32.518	0.80305 0.89508	0.14662 0.16342	29	0.852
$Rast^2 – Rast^3$	30	32.518 32.281	0.89508 0.93780	0.16342 0.17122	29	0.025
$Rast^1 – Rast^3$	30	32.541 32.281	0.80305 0.93780	0.14662 0.17122	29	0.070

Table 2 shows the participants' repeated sprint times, $rast^1$ (pre-test), $rast^2$ (powder milk use) and $rast^3$ (creatine monohydrate use). Following the evaluation of main data related to $Rast^1 – Rast^3$ and $Rast^2 – Rast^3$, non-statistically significant decreases in repeated sprint times were observed after the use of creatine monohydrate ($p > 0.05$).

Table 3. The values related to fatigue indexes (FI)

FI values	N	Avg.	Sd.	Std. error	T test	
$FI^1 – FI^2$	30	7.0020 6.3010	2.15119 2.19149	0.39275 0.40011	29	0.103
$FI^2 – FI^3$	30	6.3010 5.2487	2.19149 1.07438	0.40011 0.19615	29	0.001**
$FI^1 – FI^3$	30	7.0020 5.2487	2.15119 1.07438	0.39275 0.19615	29	0.000**

Table 3 shows the fatigue indexes of participants in 6 × 35 m sprints and reveals that FI[3] (acute creatine use) had positive effect on fatigue index. Fatigue index is a significant indicator of time differences among 6 × 35 m sprints.

Table 4. 35 m Sprint times values (seconds)

35 m sprint times values (seconds)	N	Avg.	Sd.	Std. error	T test	
Sprint[1] – Sprint[2]	30	4.9937 5.0223	0.13235 0.19491	0.02416 0.03559	29	0.308
Sprint[2] – Sprint[3]	30	5.0223 4.8839	0.19491 0.20470	0.03559 0.03737	29	0.000**
Sprint[1] – Sprint[3]	30	4.9937 4.8839	0.13235 0.20470	0.02416 0.03737	29	0.000**

Table 4 demonstrates the sprint[1] time when any food supplement was not used; sprint[2] after powder milk was used and sprint[3] after creatine monohydrate was used. Considering the 35 m sprint averages and standard deviation values of the soccer players, the effect of using acute creatine monohydrate in 35 m sprint was statistically meaningful.

Discussion

The effects of acute creatine monohydrate supplementation on soccer players' fatigue and anaerobic performances were examined in this study. With this aim, 35 m sprint times, 6 × 35 m total sprint times and fatigue indexes of the participant players were examined when no food supplement was given, after they took 0.3 gr/kg powder milk and after they took 0.3 gr/kg creatine, and these processes were statically analyzed. Fatigue index is a significant indicator of time differences among 6 × 35 m sprints. And it is an important criteria of sportive performances of soccer players. Today it is well known that there is directly positive relationship between performance and repeated spring times rather than total sprint times.

In this study, although the use of acute creatine monohydrate supplementation improved total repeated sprint time which was appointed as the indicator of anaerobic performance, no statistically difference was found. In the literature, there are various studies emphasizing different outcomes regarding the use of acute creatine monohydrate on repeated sprint performance. Many of these studies found an increase in high-intensity and short term single or repeated sprint performances when anaerobic energy metabolism was used (Ostojic, 2004; Cox et al., 2002; Izquierdo, Ibazez, Gonzales-Badillo, Gorostiaga 2002). In a study by Mujika et al. (2000), the effects of using 20 gr creatine during 6 days in 6 × 15 m repeated sprints on performance was observed. In addition, that study found statistically significant improvements in the 5 m and 15 m total sprint times ($p < 0.05$).

Oztasyonar and Atasever (2017) investigated the effects of using 10 gr and 20 gr creatine daily on 10 × 20 anaerobic exercises with 30-second breaks between sprints. The participants who took 20 gr creatine daily performed significantly better in sprints compared to controls. Investigating the biomechanical source of creatine loading on sprint performance, Schedel, Terrier, Schutz, (2000) discovered that there was an increase in step frequency of the athletes taking creatine, which might stem from the shortening in muscle contraction and relaxation occurred as a result of intense intracellular phosphocreatine (pc) (Oztasyonar, Atasever, 2017).

During 6 second or faster sprints, anaerobic sources are used for ATP production (Girard et al., 2011), and it is reasonable to expect a decrease in sprint times because it is expected that creatine use will cause an increase in anaerobic capacity. Redondo, Dowling, Graham, Almada, Williams (1996) found that with ice hockey and soccer players, statistically significant differences were not found in 3 × 60 m sprints with 2 minute resting breaks between the sprints. The reason for the differences among the study results might be the variability in the number of repeated sprint times or possible influences of energy sources. For the current study, the reason for no statistically meaningful difference in performance improvement in 6 × 35 m total repeated sprint times can be the selected protocol.

Regarding the 35 m single sprints in the current study, the performance increase following the use of creatine monohydrate was statistically meaningful ($p < 0.05$). Ostojic (2004) showed that the sprint performances of soccer players improved after creatine loading. In a similar study, Guner et al. (1999) observed the effects of creatine loading on sprint performance and discerned that 0.3 gr./kg creatine loading during 4 days positively influenced sprint performance. The reason for such an improvement in sprint performance after a creatine loading might stem from the increase in creatine phosphate storages in muscles.

In addition, the effects of creatine monohydrate on fatigue index were examined in the current study. As indicated by the statistical data, the use of acute creatine monohydrate had strong positive effects on fatigue index. That is, the difference between the best and the worst rate among the 6 × 35 m sprints was found to decrease. In general, the difference between the sprints of the athletes with high VO_2max values was expected to be low (Eniseler, Gunduz, 2001). If the aerobic power of an athlete is of high alactic anaerobic power, he can perform well in single and repeating sprint times although performance losses can be observed as the number of the repeats increase, because ATP-CP cannot be supplied thoroughly during repeated sprints that are performed with short breaks (Karatepe, 2009).

Significant differences were found in single repeated sprint values, and the improvements in fatigue index during repeating sprints show that the use of creatine facilitates the refilling of ATP-CP storages. These findings are parallel with those in the current literature, and have become an indicator of an increase in anaerobic performance, because the availability of creatine phosphate is of vital importance for power production during the first several seconds of exercise (Mujika, 2000). That the recovery becomes faster between high intensity and short term anaerobic loading with the use of creatine, demonstrates that the losses between repeated sprint times decrease, that is, the performance losses decrease. The creatine phosphate re-synthesis during the recovery period can be enhanced with creatine loading (Buford et al., 2007). This is in a direct and positive relationship with the performance needs of today's soccer.

In conclusion, considering the findings in the study and in the literature, 0.3 gr/kg creatine monohydrate loading during the 5 days had statistically significant effects on single repeated sprint times and fatigue index. In soccer, creatine monohydrate can be used as an ergogenic supplement since the recovery period between the high intensity efforts is known to impact performance. In the study, no significant difference was found in single repeated sprints on total time performance. However, the number of the studies on the effects of creatine loading on repeat sprint average time is quite high, and there is also research indicating that it affects the performance positively.

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