SHORT TERM CREATINE LOADING WITHOUT WEIGHT GAIN IMPROVES SPRINT, AGILITY AND LEG STRENGTH PERFORMANCE IN FEMALE FUTSAL PLAYERS

Summary

Objectives. Futsal game requires players to perform frequent bouts of high-intensity activity with limited rest periods that are not sufficient for full recovery. Therefore, creatine supplementation may enhance performance by improving recovery rate. Along with this, the number of studies conducted to determine the effects of creatine on performance in the females is scarce. Thus, the main aim of this study is to identify the effects of short-term (7/day) creatine supplementation on leg strength, velocity and agility in young female futsal players.

Equipment and methods. A total of thirty of young female futsal players (aged: 19.83±1.13 years) participated in the study which was designed as randomized and double-blind, on a voluntary basis. Participants were randomly assigned either to Creatine (n=15) or Placebo (n=15) group. Over 7 days, Creatine group received 0.25 g/kg/day micronized pure creatine monohydrate (Creapure, Hardline Nutrition, Kavi Gıda Istanbul, Turkey) and placebo group did not take any supplements, apart from maltodextrin (Fantomalt, Nutricia, United Kingdom). Before and after 7 days of loading creatine supplementation, body weight, leg strength, velocity and agility performance of the participants were determined. The data obtained were analysed with ANCOVA statistical model.

Results. Creatine supplementation significantly improved 10m, 20m and 30m speed performances ($p<0.05$), leg strength ($p<0.05$) and agility ($p<0.05$) in female futsal players. Depending on the creatine loading, however, no significant change in body weight was observed ($p>0.05$). The data obtained provide that 7 days low dose creatine supplementation may be an effective approach for improving exercise capacity in female futsal players without an associated increase in body weight.

Key words: Creatine, ergogenic aid, futsal, female, performance

LA CHARGE DE CRÉATINE À COURT TERME SANS GAIN DE POIDS AMÉLIORE LA PERFORMANCE DU SPRINT, DE L'AGILITÉ ET DE LA RÉSISTANCE AUX JAMBES CHEZ LES JOUEUSES FUTSAL FÉMININES

Résumé

Objectifs: Le jeu de futsal exige que les joueurs effectuent de fréquentes périodes d'activité de haute intensité avec des périodes de repos limitées qui ne sont pas suffisantes pour une récupération complète. Par conséquent, la supplémentation en créatine peut améliorer les performances en améliorant le taux de récupération. Parallèlement à cela, le nombre d'études menées pour déterminer les effets de la créatine sur la performance chez les femmes est rare. Ainsi, le but principal de cette étude est d'identifier les effets de la supplémentation en créatine à court terme (7/jour) sur puissance des jambes, la vélocité et l'agilité chez les jeunes joueuses de futsal féminines.

Équipement et méthodes: Au total, une trentaine de jeunes joueuses de futsal (âgées de 19,83 ± 1,13 ans) ont participé à l'étude, conçue comme une étude randomisée et en double aveugle, sur base volontaire. Les participants ont été assignés au hasard soit au groupe Créatine (n = 15) ou au groupe Placebo (n = 15). Sur 7 jours, le groupe Créatine a reçu 0,25 g / kg / jour de monohydrate de créatine pure micronisée (Creapure, Hardline Nutrition, Kavi Gida Istanbul, Turquie) et le groupe Placebo n'a pas pris de suppléments hormis la maltodextrine (Fantomalt, Nutricia, Royaume-Uni). Avant et après 7 jours de chargement de supplémentation en créatine, le poids corporel, la force des jambes, la vélocité et l'agilité des participants ont été déterminés. Les données obtenues ont été analysées avec le modèle statistique ANCOVA.

Résultats: La supplémentation en créatine a significativement amélioré les performances en vitesse de 10m, 20m et 30m ($p < 0.05$), la force des jambes ($p < 0.05$) et l'agilité ($p < 0.05$) chez les joueuses de futsal. Cependant, en fonction de la charge en créatine, aucun changement significatif du poids corporel n'a été observé ($p > 0,05$). Les données obtenues indiquent qu'une supplémentation en créatine à faible dose de 7 jours peut être une approche efficace pour améliorer la capacité d'exercice chez les joueuses féminines de futsal sans augmentation associée du poids corporel.

Mots-clés: Créatine, aide ergogénique, futsal, féminines, performance

1. Introduction

In the last three decades, futsal game has reached an increasing popularity and also developed so fast after its full accreditation by the Fédération Internationale de Football Association (FIFA) in 1989. Similarly, studies conducted over futsal have been expanding and reached to 88 Pubmed publication in 2016 April from 52 in 2014 August (1). Futsal is an indoor model of soccer with the high physical demands and consisting of 5 players in each team including a goalkeeper. According to the futsal game motion-time analysis, it has been shown that futsal has intermittent high-intensity movement features dominantly (2). Additionally, some different features of futsal game, such as the smaller playing area, frequent and fast direction changes, require quick decision making, which ensues repeated sprints and agility capacity as crucial factor to improve in performance (1, 3, 4). On the other hand, from the biochemical point of view, the creatine/phosphocreatine (PCr) system can supply phosphate to the cell to compensate adenosine triphosphate (ATP) deficit during high-intensity workouts (5, 6). Due to the aforementioned use of creatine phosphate during high-intensity exercises, Creatine monohydrate (CrM) supplementation has become very popular particularly in soccer (7) and some other team sports (8). Particularly, 7 days CrM loading has been shown to improve sprint power, endurance, dribble and a vertical jump test (9) which have been using to simulate the soccer game movements and exercises (7). Another short-term creatine (Cr) loading study has been applied over 6 days and found improvements in agility and repeated sprint performances in highly trained female soccer players (10). Along with this, some studies found 7 days Cr supplementation with no effect on dribbling, agility (with and without the ball) and sprint performance in male futsal players (11). To our knowledge, there is only one study evaluating Cr loading on motor performance in female futsal players over two weeks, where the possitive effect of Cr supplementation wingate anaerobic power, capacity, 20 m sprint and, muscular power performance were demonstrated (12). So the aim of this study is to assess effects of a short-term (7 days), low dose Cr loading on sprint performance, leg strength and agility in elite female futsal players. The experimental exercise tests used in this study were selected based on similar activity patterns with futsal game.

2. Materials and Methods

2.1 Participants

This study was conducted in the Department of Physical Education and Sport at Dumlupinar University in Kutahya, Turkey. Thirty highly trained Turkish female futsal players (19.8 ± 1.14 years, 164.2 ± 6.47 cm, 56.2 ± 6.34 kg) from the same team voluntarily participated in this study. A written consent was obtained from the subjects after they were thoroughly informed of the purpose and potential risks of participating in the study. All experimental tests and procedures were conducted according to the declaration of Helsinki and all participants understood and signed an informed consent which was approved by the university ethical board. All subjects were competing in the Turkish first division women futsal league during the course of the study. They've had minimum continuous futsal training background of 4.53±.83 yr of experience. None of the participating players was vegetarian or ate unusually large quantities of meat. This study was performed in February, which was the official league break period and no official game was played so. Only the subjects who had never been supplemented with CrM/maltodextrin or had never used anabolic steroids, were allowed to participate in this study to avoid unknown possible physiological adaptations.

2.2. Experimental Design

A double-blind, placebo-controlled, randomized design was used in this study. After the baseline anthropometric measurements, the subjects were assigned to either a creatine group (CrG n= 15) supplementation group or a placebo (PlG n= 15) group by using the online research randomizer (https://www.randomizer.org/) website. All trials were performed approximately at the same time of the day, between 14 pm to 16 pm. After that; 10m, 20m and 30m sprints, agility and leg strength performance tests were applied, respectively. Five minutes rest were given between each test. The same protocol was repeated after 7 days Cr supplementation. Subjects were instructed to maintain their normal diet throughout the testing period, to avoid food and drink in the hour before each trial. None of them declared using dietary supplements for at least 2 months before the baseline. All of the subjects underwent the same training schedules during the protocol and also they were familiarized with each exercise testing protocol separately, moreover, during the previous season they had been tested with the same testing procedures several times.

2.2.1. Supplementation Protocol

After pretreatment testing, subjects were divided into either CrG or PlG. None of the subjects had ingested CrM, or any other dietary supplements before initiation of the study. CrG group received 0.25 g/kg/day micronized pure CrM (Creapure, Hardline Nutrition, Kavi Gıda Istanbul, Turkey) for 7 days. PlG group received 0.25 g/kg/ day maltodextrin (Fantomalt, Nutricia, UK) for 7 days, which was matched with the Cr powder for taste and colour. The supplement was equally divided into two for consuming in breakfast and dinner to avoid the reduction in urinary creatinine excretion and increase in whole-body retention of Cr (13). Subjects mixed their supplement with ~300 mL of a warm water before consuming. During the course of the study, the subjects were asked to refrain from exhaustive physical activity, caffeine and alcohol consumption for 24 hours prior to testing.

2.2.2 Anthropometric Measurements

Before and after the supplementation protocol was started applying, body height and body weight of the participants was measured with a standard digital scale accurate to the nearest ± 1 mm (Holtain Ltd. U.K.) and scale accurate to the nearest 0.1 kg (Tanita TBF 401 A Japan), respectively. All pre and post measurements were conducted at the approximately same time of the day.

2.2.3. Leg Strength

The isometric leg strength of 30 subjects was measured using Takei (Takei Kiki Kogyo, Tokyo, Japan) portable, back and lift dynamometer and results were saved as kg. All subjects stood upright on the base of the dynamometer with their feet shoulder-width apart. They were asked to bend their back slightly forward at the hips and to hold their head upright. In this position, they were requested to look straight ahead. Then without bending their back, they were asked to pull as hard as possible on the chain and try to straighten their legs, keeping their arms straight. They pulled against the weight steadily (no jerky movements), keeping the feet flat on the base of the dynamometer. The maximum performance was recorded when their legs were almost straight at the end of the lift. The result from the dynamometer was read after the test. Two attempts were given to the participants and the best score was recorded.

2.2.4. Sprint Test

The sprint runs were performed in the indoor futsal court. After a standardized 15-min warm-up period that included low-intensity running, several accelerations runs, and stretching exercises, both Cr and Pl group undertook a sprint running test consisting of three maximal sprints of 10, 20, and 30 m with a 60-s rest period between each test. During the 60-s recovery period, the subjects walked back to the starting line. The running time of the sprints were recorded using Newtest Powertimer 300 photocells (Oulu, Finland). The photocell gates were placed at 10 m, 20 m and 30 m. All distance was run twice and the best time was recorded.

2.2.5. Agility Test

The Illinois agility test (IAT) was used to measure agility during sprints including direction changes without stopping, and running at different angles. This measurement was conducted using Newtest Powertimer 300-series photocells (Oulu, Finland). Participants performed two trials of the agility test with five minutes recovery between trials. The best time of the two trials was recorded to use for statistics.

2.2.6. Statistics Analysis

The statistical analyses were performed using the SPSS version 21.0 software package (SPSS Inc., Chicago, IL, USA). Data are presented as mean ±SD. ANCOVA with baseline time measurement serving as the covariate in order to test for group differences in agility, strength and sprint tests after Cr supplementation was used to analyze the data. Statistical significance was set at $\alpha \leq 0.05$.

3. Results

Total thirty female futsal players (age: 19.83±1.13 yrs, height: 164.20±6.47 cm, BW: 56.23±6.34 kg) agreed to participate in the study and they all completed the study. There were no differences existed among groups at the beginning of the study in terms of age, BW, height, body mass index and training background (Table 1; $p>0.05$). All subjects reported adherence to the experimental protocol and completed ingestion of the supplement. The results of performance tests applied in the study were demonstrated in Table 2. The results obtained showed that short-term Cr supplementation had no significant effect on BW ($p>0.05$; Table 2). Along with this, 7 days of Cr supplementation (0.25 g/kg/d) resulted in

increasing 10m, 20m, and 30m sprint performance in CrG compared with PlG (0.03; $p<0.05$, 0.30; $p<0.05$, 0.00; $p<0.05$, respectively; Figure 1, Table 2).

CrG showed statistically significant increase in leg strength when compared to their baseline value (pre: 106.2±13.0 kg, post: 117.9±12.98 kg; $p<0.05$). Using baseline time measurement serving as the covariate, CrG had higher leg strength compared with PlG's post value (CrG post: 106.2±13.0 kg, PlG post: 81.70±17.29 kg; $p<0.05$, Table 1, Figure 2).

After Cr supplementation loading, agility performance in CrG improved statistically significant compared with both their baseline value (pre: 18.33±0.92 sec, post: 17.60±0.88 sec; $p<0.05$, Figure 3) and PlG post value (CrG post: 17.60±0.88 sec, PlG post: 16.72±0.34 sec; $p<0.05$, Figure 3).

4. Discussion

The major findings of this study were that short-term CrM supplementation improved multiple sprints, agility and leg strength performance in female futsal players following 7 days of loading without an associated increase in BW. Although direct measurement of muscle Cr was not done, the reported compliance of subject to a proven Cr loading protocol provides indirect support of the success of our supplementation protocol. While there is only one study published so far where authors aimed to know the effect of long-term Cr supplementation in female players (12), to our knowledge, we are the first to assess the efficacy of short-term Cr supplementation on performance in female futsal players performing a sports-specific activity.

The substantial results obtained in this study provide that Cr supplementation can be used by female athletes to improve physical performance. Our results are consistent with other existing studies on Cr supplementation, showing the ergogenic effect of Cr supplementation on exercise performance (14-16). In a review prepared by Miny and et al. related to Cr supplementation in soccer, it has been clearly suggested that Cr loading may be an effective strategy to enhance performances including muscle strength, sprint, and vertical jump (17).

In this study, Cr supplementation significantly improved sprint performance in 10m, 20m, and 30m. These results are similar to previous findings (8, 18, 19). Some groups have failed to find improvements in the repeated sprint performance after Cr loading (20, 21). This discrepancy may be attributed to the difference in the experimental design and the choice of

the performance outcome. The results obtained in this study showed that acute Cr supplementation provides a potential benefit in energy provision during very short-term, high-intensity exercise. This may be the reason of the increase in sprint performance after loading Cr. In addition, another mechanism that should be emphasized here is that expected increase in muscle PCr after loading Cr supplementation, which was shown in a study conducted by Casey (22). This would have been an effect on sprint performance. In a detailed consensus statement on Cr supplementation by Terjung and et al. (2000) demonstrated that an increase in PCr ranging from 10–20% achieved by Cr supplementation may contribute to improving performance during a 30-s sprint due to the 2.5–5% increase in energy supply (18). These findings explain the improvements seen in sprint performance in this study after loading Cr supplementation.

Agility performance test time was shorter in the CrG compared to both CrG baseline value and PlG post after loading. These findings of improved performance in agility test are one of the most important part of loading Cr supplementation when taking into account that futsal players have to achieve high-intensity activity during the game. As being similar to our finding, some studies reported an increase in agility test performance after Cr loading (10, 23). A study conducted by van Leemputte and et al., (1999) demonstrated that increase in intracellular stores of PCr would lead to improved efficiency of sarcoplasmic Ca^{++}-ATPase activity and cross-bridge cycling, thereby decreasing the energy costs of human skeletal muscle relaxation (24). As a result of these adaptations, power production by skeletal muscle would increase and maximal high-intensity muscular contractions could be sustainable for a greater period of time (24). According to this theory, mechanisms underlying these effects would facilitate the rapid and repeated muscle actions required agility, leading to an enhanced performance in agility performance (23).

Other physiological parameter measured after Cr supplementation was leg strength of the participants. The results showed that Cr supplementation resulted in increasing in leg strength. These results are consistent with those studies showing the effects of Cr on strength (19, 23, 25). In a study conducted by Brose and et al. (2003), it was found efficacy of Cr on strength (26). Another study conducted by Urbaski and et al., (1999) observed an increase in maximal isometric leg strength following 7 days of Cr supplementation (25gr/kg/d) (27). Wiroth and et al., (2001) showed an increase in maximal strength after 5 days of Cr loading (19). After Cr loading, this observed increase can be attributed to increasing in the level of

PCr in muscle (28). This assumption was supported by a study where vastus lateralis muscle taken, showing this expected increase in PCr after Cr loading (22).

With few exceptions including the current one, almost all studies so far conducted have reported increases in BW of 0.5–3.0 kg after Cr supplementation (7, 8, 29-33), some studies have not (34-38). Possible reason behind this discrepancy may be explained with different loading protocols applied in a different population. It is well known that a possible mechanism underlying the short-term Cr-induced increase in BW is associated with the increases in water retention in the intramuscular space as a result of the cellular transport of Cr with Na^+ (39) or a creatine-stimulated increase in myofibrillar protein synthesis (40). However, short-term Cr loading applied in the current one didn't cause an increase in BW in this study as seen. This may be explained with the training during the supplementation, which may have been too intense and high in volume to allow sufficient gain in BW.

6. Conclusion

Cr supplementation used by athletes engaged in multiple sprint events, such as soccer and other team sports has become popular recently. Due to its specific characteristic, futsal performance that contains high intensity and short-term movement without resting period, can be improved by loading Cr. Additionally, the effect seen in football players after Cr supplementation cannot be generalized to futsal players because of the difference between football and futsal. Taking into account all of these, to our knowledge, we are the first to show the effects of short-term (7-days) Cr supplementation on physical performance in female futsal players. In conclusion, short-term Cr supplementation (0.25 gr/kg/d) is effective for increasing performance in female futsal players following 7 days of loading without an associated increase in BW.

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Conflict of Interest

The authors declare that they have no competing interest.

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