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Original

Effects of creatine supplementation in taekwondo practitioners

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Abstract

Introduction: **Taekwondo (TKD) is a combat sport, which has also been proposed as a fitness program, with a strong anaerobic component. Creatine (Cr) supplementation is used to improve both anaerobic exercise performance and body composition. Therefore, Cr supplementation could be beneficial in TKD.**

Aims: **To determine the effect of Cr supplementation (50 mg/kg body wt) on body composition, anaerobic power and blood chemistry in young male TKD practitioners.**

Methods: **Ten male TKD practitioners (age [20 ± 2 yr], height [1.69 ± 0.06 m], and mass [67 ± 9.8 kg]) participated in a placebo-controlled, double blind, crossover study. Body composition (DEXA), anaerobic power (Wingate Test), blood lactate and blood chemistry were measured before and after supplementation. Differences between data before and after supplementation were calculated for each treatment (Cr and Placebo) and were compared using the Wilcoxon signed-rank test.**

Results: **Fat mass (kg) decreased after placebo (Mdn [IqR] = -0.75 [-1.44 to 0.03]) and increased following Cr intake (0.17 [-0.77 to 1.13] kg) (Z = 2.191, p < 0.028, r = 0.49). Serum triglyceride concentration (mg/mL) increased after Cr (45.00 [-7.50 to 75.00]) and decrease with placebo (-7.00 [-10.75 to 12.00]) (Z = 2.090, p < 0.037, r = 0.47). No changes were found in others parameters.**

Conclusion: **Cr supplementation may increase fat mass and serum triglycerides concentration in young male TKD practitioners without improvement in anaerobic power. Cr supplementation appears to be safe, but athletes should be careful when they want to loss fat.**

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Key words: *Dietary supplement. Martial arts. Wingate test. Body fat. Triglycerides.*

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EFECTOS DE LA SUPLEMENTACION CON CREATINA EN PRACTICANTES DE TAEKWONDO

Resumen

Introducción: **El Taekwondo (TKD) es un arte marcial, que ha sido propuesto también en programas de actividad física, con un fuerte componente anaeróbico. La suplementación con creatina (Cr), utilizada para mejorar el rendimiento deportivo y la composición corporal, puede ser beneficiosa en TKD.**

Objetivos: **Determinar el efecto de la suplementación de Cr sobre la composición corporal, potencia anaeróbica y bioquímica sanguínea en practicantes jóvenes de TKD.**

Métodos: **Diez practicantes varones de TKD (edad [20 ± 2 años], estatura [1,69 ± 0,06 m], peso [67,0 ± 9,8 kg]) participaron en un ensayo aleatorizado cruzado (grupo control + placebo). Se evaluaron (pre-post suplementación) la composición corporal (DEXA), la potencia anaeróbica (Test de Wingate), el lactato y la bioquímica sanguínea. Se calculó la diferencia entre los valores pre y post ingestión para ambos tratamientos (Cr y placebo) y se compararon las diferencias usando la prueba de signos y rangos de Wilcoxon.**

Resultados: **La masa grasa (kg) disminuyó después del placebo (Mdn [IqR] = -0,75 [-1,44 a 0,03]) mientras que con Cr se elevó significativamente (0,17 [-0,77 a 1,13] kg) (Z = 2,191, p < 0,028, r = 0,49). La concentración sanguínea de triglicéridos (mg/mL) aumentó con Cr (45,00 [-7,50 a 75,00]) y disminuyó con Placebo (-7,00 [-10,75 a 12,00]) (Z = 2,090, p < 0,037, r = 0,47). No hubo cambios significativos en otros parámetros.**

Conclusiones: **La suplementación con creatina puede incrementar la masa grasa y la concentración sanguínea de triglicéridos en jóvenes practicantes de TKD, sin mejorar la potencia anaerobia. La suplementación parece ser segura, pero es necesario ser cuidadosos cuando se busca disminuir el peso corporal.**

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Palabras clave: *Suplemento nutricional. Artes marciales. Grasa corporal. Test de Wingate. Triglicéridos.*

Abbreviations

ATP: Adenosine triphosphate.
BF%: Body fat percentage.
BFLM: Bone free lean mass.
BM: Total body mass.
BMC: Bone mineral content.
Cr: Creatine.
DEXA: Dual energy x ray absorbtiometer.
FM: Fat mass.
PCr: Phospocreatine.
TKD: Taekwondo.

Introduction

Taekwondo (TKD) is a combat sport and an Olympic discipline with about one million of practitioners worldwide.[1] TKD has also been proposed as a fitness program highly demanding for most muscle groups of the body.[1,2] Although TKD improves both aerobic and anaerobic capacities,[3,4] some studies suggest that anaerobic metabolism is the main source of energy in TKD.[1,4,5]

Phosphocreatine (PCr) is one the most important substrates for adenosine triphosphate (ATP) re-synthesis during high intensity exercise bouts, and it is generally accepted that the development of fatigue during maximal short duration exercise is associated with the depletion of muscle PCr stores.[6] Creatine (Cr) and PCr serve to continuously preserve intracellular ATP availability, modulate metabolism and buffer ion accumulation during muscle contraction.[6] Hultman et al.[7] were the first to describe that muscle total Cr concentration increased by approximately 20% in young men after 6 days of Cr supplementation at a rate of 20 g/day or 3 g/day by 28 days. This elevated concentration was maintained when supplementation was continued at a rate of 2 g/day for a further 30 days. After that, athletes have used Cr supplementation in an attempt to improve exercise performance by delaying PCr depletion and the rate of adenosine diphosphate (ADP) accumulation during maximal exercise, to promote PCr re-synthesis during repeated bouts of maximal short-duration exercise, and to optimize body composition.[8,9] Nevertheless, it has been suggested that high doses of Cr supplementation (20 g) may be related to renal or liver damage,[10,11] gastrointestinal discomfort,[12] dehydration and muscle cramping;[13] whereas low doses (3 to 7 g) have been shown to be safe and effective.[7,14]

In all TKD practitioners, athletes and non-athletes, the most desirable characteristics are low levels of body fat,[4,5] high anaerobic abilities,[3-5,16] elevated aerobic fitness,[3,4,15,16] strength,[4,15] and flexibility.[4,15] To our knowledge, although Cr supplementation should be beneficial in TKD due to its role as energy source, there is no research examining the effects of Cr supplementation in TKD players. Therefore, the purpose of the present study was to conduct a placebo-controlled, double blind, crossover study to determine the effect of oral Cr supplementation on body composition, anaerobic power and blood chemistry of young TKD practitioners.

Materials and methods

Subjects

Twelve healthy, non-smoking, non-vegetarian, red and black belt male recreational TKD players (age = 20 ± 2 yr; height = 1.69 ± 0.06 m, mass = 67.0 ± 9.8 kg) were recruited from the Universidad Autónoma del Estado de México's team. They had a training history of 3-5 years. All subjects were free from chronic disease and were not regularly taking medical prescription, were not consuming any ergogenic aids and had never been supplemented with Cr. Subjects were fully informed of all procedures and signed a consent form prior to the study, which carried the approval of the University Ethics Committee, in according to the principles of the Declaration of Helsinki.

Subjects trained normally (3 times per week; ~2 hours per day) before the study. The typical TKD training session consisted of three phases: (a) a 30 minute warm-up period during which non-TKD activities (10 min running, and 20 min flexibility exercises) were performed to prepare for higher intensity activities; (b) a 60 minute period after the warm up in which TKD fundamental techniques (sets of punches, kicks, blocks, etc.) were performed and repeated with gradually increasing intensity; and (c) a 20 minute cool-down period divided into 10 min of running and walking performed to gradually reduce the heart rate to the levels reached at the end of the warm up period and then 10 min of flexibility exercise to finish the session. This same training schedule was maintained during the study.

Supplementation protocol and experimental procedure

A double-blind, crossover design was utilized where subjects were randomly assigned to either groups A or B which received for 6 weeks either Cr supplementation (experimental treatment) or placebo (control treatment), respectively. After a 6-week wash-out period, groups were then assigned to the opposite treatment for another 6 weeks (fig. 1). Experimental treatment consisted of 1 dose of Cr/day (50 mg/kg body weight per dose) for 6 weeks. Each dose was provided by means of a soft drink with ~3.5 g of Cr monohydrate (Future Foods, Dover, NJ, USA; batch number 050467 with 99.92% reported purity), 30 g of sucrose, artificial flavoring and food coloring in a water volume of 500 ml. Control treatment consisted of the same soft drink; but, with 3.5 g of maltodextrine, instead of Cr, as placebo. Both soft drinks had similar taste and appearance and were placed in generic bottles with a personal code for each subject to ensure

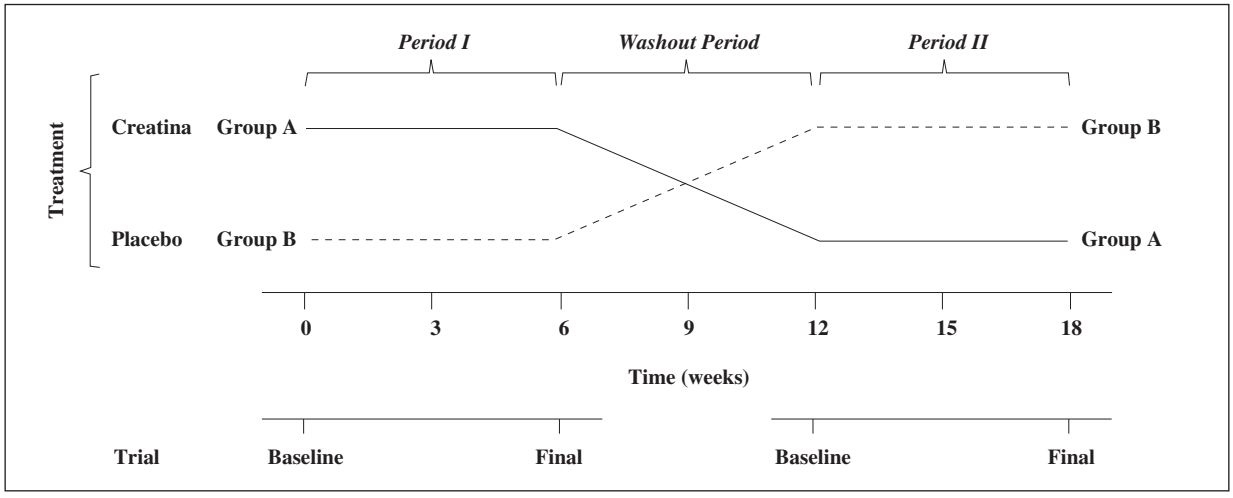

Fig. 1.—Experimental design of the study. Participants were randomized into two groups: group A (n = 6) was supplemented with Cr for a 6-week period and, after a wash-out period, ingested placebo for another 6-week period; group B (n = 6) ingested placebo for a 6-week period and, after the wash-out period, was supplemented with Cr for another 6-week period.

double-blind administration. On training days, subjects consumed 250 mL of soft drink one hour before exercise and the rest of the drink immediately after exercise. On non- training days, subjects consumed the soft drink any time during the day. Also, subjects were instructed to maintain their same diet during the study assuming no changes in their dietary habits due to their controls were themselves. In addition, subjects were concentrated in the sports facilities of the Universidad Autónoma del Estado de México, from Sunday (9 hrs) to Monday (9 hrs), in each trial in order to control food ingestion before blood sampling and evaluated anaerobic power. During both Sunday and Monday, all subjects had the same food menu, which was elaborated for a qualified nutritionist. Finally, compliance was 4/6 for Group A and 6/6 for Group B; two subjects in group A were excluded because of an injury during, but unrelated, to training (fig. 2).

Body composition

DEXA (dual energy x ray absorbtiometer) is the most common and reliable method for the analysis of the body composition.[17,18] It was assessed using a fan beam DEXA Prodigy model (GE/Lunar Corp, Madison, Wisconsin, USA). We determined total body mass (BM), bone free lean mass (BFLM), bone mineral content (BMC), fat mass (FM) and body fat percentage (BF%).

Subjects were tested between 18 and 20 hrs on Fridays and Saturdays before the Wingate test, or between 10 and 12 hrs on Mondays after the Wingate test. Each individual subject was tested at the same time of day for each trial. All participants were requested to take off all removable objects containing metal (i. e. clothing with buttons and/or zippers, jewellery, watch, etc.) before scanning. Scans were performed with subjects lying in a supine position along the scanning table's centerline longitudinal axis. They were instructed to maintain their hands in a prone position, and their legs and hands immobilized within the scanning region during study.

Anaerobic power

Anaerobic power was determined using the 30 s Wingate anaerobic test. One week before first trial, subjects had a familiarization session. In this session, detailed instructions were given to the subjects about Wingate test procedures and they performed it twice; also, both the optimal seat height and the maximal pedaling speed were determined for each subject and they were recorded in order to replicate it in subsequent tests.

On test sessions, subjects were evaluated on Sundays between 10 and 14 hrs, each subject was tested individually at the same time of the day in every trial. On arrival at the laboratory, subjects were weighed and their BM (kg) was recorded to calculate the load to apply during the test. The test was performed on a calibrated cycle ergometer (Monark Ergomedic 818 E, Stockholm, Sweden) equipped with toe clips with straps to avoid feet slip out of the pedals. A warm-up period was performed, which comprised light intensity cycling without load for 2-4 min reaching a heart rate between 150 and 160 beats/min; after that, subjects rested for 3 min before the test on the cycle ergometer. Then, at the researcher's command, subjects started to pedal quickly to reach their maximal pedaling speed, previously recorded; when they get at it, a load of 7.5% of subject's BM (kg)[19] was applied and pedal revolutions were recorded. Subjects were verbally motivated to maintain as high pedaling rate as possible throughout the 30 s test. We determined the maximum anaerobic power (the highest power achieved at any given 5 s period in watts [W]),

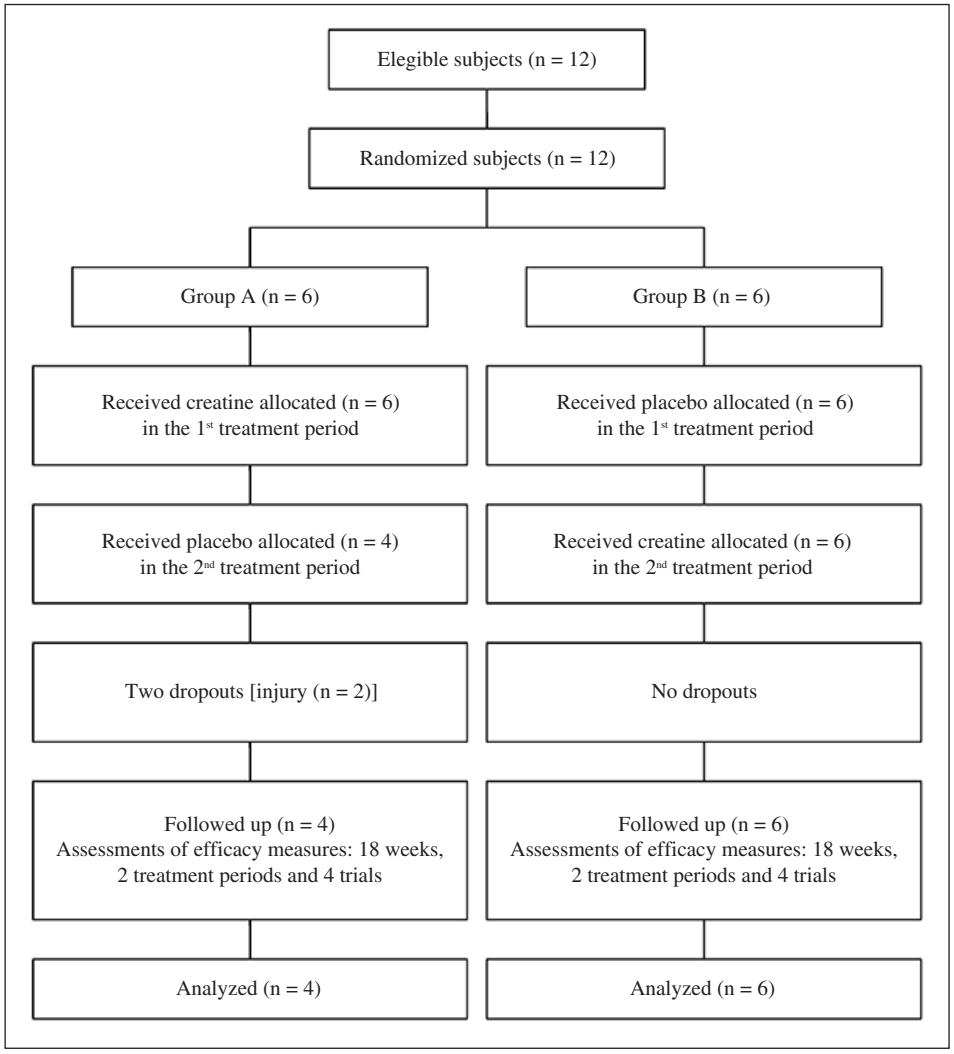

Fig. 2.—Flow chart of participants during the study.

medium anaerobic power (the average power of the entire 30 s test in W), and the fatigue index (maximum anaerobic power minus the lowest power output at any 5 s period and it divided by the maximum anaerobic power; and expressed as a percentage [%]).

Capillary blood samples were obtained from a finger-tip puncture, after 5 min of recovery from the Wingate test,[20] and blood lactate concentration (mmol/L) was determined by means of a portable Lactate analyzer (Accutrend Lactate, Roche Diagnostics, Mannheim, Germany).[21]

Blood chemistry

Blood sampling was carried out before and after of both supplementation periods. After an overnight fast, subjects reported to the laboratory between 7 and 9 hrs. Blood samples (~10 mL) were collected from the antecubital vein with minimal stasis by venipuncture into evacuated serum separation tubes (Vacutainer®, Becton Dickinson, USA). Serum separation tubes were centrifuged for 10 min at 2,500 rpm to separate serum. Serum samples were subsequently analyzed for glucose, urea, serum creatinine, triglycerides and total cholesterol concentration (mg/dL), and enzymes activities (alanine amine transferase, aspartate amine transferase, gamma-glutamiltransferase, lactate dehydrogenase; IU/L). Analysis of samples was carried out with commercial reagents (Randox Laboratories Ltd., United Kingdom) in an automated chemistry analyser (Vitalab Selectra-2, Merck, México).

Statistical analysis

For statistical analysis, data from period I and II of both groups A and B (fig. 1) were grouped by treatment (Cr or placebo); and differences between baseline and final trials were calculated for each treatment. Results from differences of both treatments were compared using the Wilcoxon signed-rank test for all variables. Significance level was set at the level of $p < 0.05$; and the effect of size *(r)* was calculated by dividing Z from Wilcoxon

Table I
Body composition by DEXA

		Treatment [Mdn (IqR)]	
	Trial	*Placebo*	*Creatine*
Body mass (kg)	Baseline	66.91 (58.63 to 71.70)	68.43 (58.63 to 73.10)
	Final	66.74 (58.63 to 70.74)	69.06 (58.43 to 74.47)
	Δ	-0.17 (-1.15 to 0.73)	0.29 (-0,43 to 2.11)
Bone free lean mass (kg)	Baseline	51.78 (45.71 to 55.53)	51.37 (46.36 to 55.83)
	Final	50.71 (46.96 to 56.24)	51.87 (46.86 to 55.47)
	Δ	1.00 (-1.00 to 1.51)	0.62 (-0,71 to 1.20)
Bone mineral content (kg)	Baseline	3.06 (2.94 to 3.26)	3.06 (3.00 to 3.27)
	Final	3.06 (2.93 to 3.28)	3.06 (2.97 to 3.32)
	Δ	0.00 (-0.02 to 0,02)	0.00 (-0.01 to 0.02)
Fat mass (kg)	Baseline	11.43 (8.97 to 14.56)	11.71 (8.59 to 16.19)
	Final	10.26 (7.95 to 13.33)	12.54 (8.32 to 14.85)
	Δ	-0.75 (-1,44 to 0.03)	0.17 (-0.77 to 1.13)*
Body fat (%)	Baseline	17.70 (15.03 to 23.23)	18.85 (15.13 to 22.60)
	Final	16.45 (12.20 to 22.30)	18.55 (14.93 to 23.20)
	Δ	-0.85 (-2.13 to -0.15)	0.05 (-1.43 to 1.65)

Data are *Mdn (IqR)* = Median (Interquartile Range [percentile 25th to 75th]) from n = 10 subjects; Δ = Final-Baseline; *p < 0.05 *vs.* placebo from Wilcoxon signed-rank tests.

signed-rank test by the square root of the total number of subjects. All results are expressed as Median *(Mdn)* and Interquartile Range *(IqR;* percentile 25th to 75th). Data analyses were performed on SPSS© for Windows® (version 15.0, SPSS Inc., Chicago, Illinois, USA).

Results

Subjects

At the end of the each supplementation period, subjects were asked whether they were aware of the treatment they had received. After either experimental or control treatment, all subjects reported that they were unsure about the treatment. No signs of gastrointestinal distress, muscle cramping or any other side effects were reported.

Body composition

Results of DEXA analysis are shown in table I. There was a significant difference between treatments in FM (Z = 2.191, p < 0.028, r = 0.49); subsequent to placebo administration, subjects FM decreased whereas after Cr supplementation it increased. Comparing FM results from treatments for each subject; we observed that 7 subjects in placebo treatment had a decrease in FM whereas 2 had an increase, and only one did no change (fig. 3). On the contrary, 6 subjects in Cr treatment increased their FM, whereas had a decrease (fig. 3). Also, we noticed that two subjects, who decreased FM after Cr supplementation, had a larger decrease after placebo supplementation (fig. 3). No differences were observed for BM, BFLM, BMC or BF%.

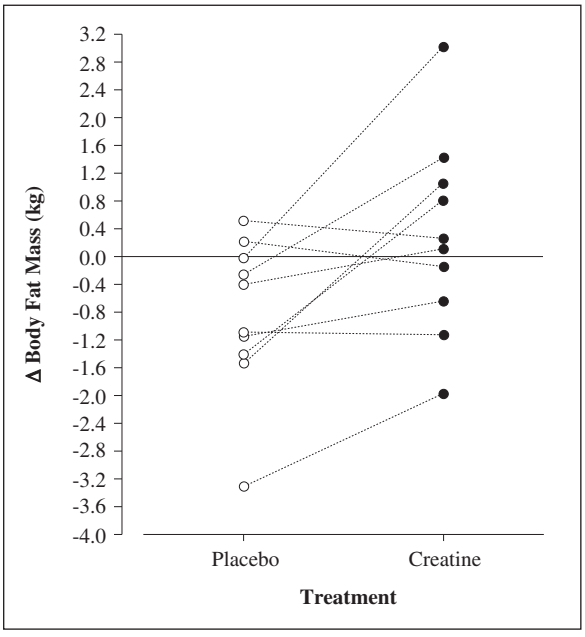

Fig. 3.—Individual differences in body fat mass.

Anaerobic power

Results of the 30s Wingate anaerobic test are shown in table II. Non-significant differences between treatments were found in anaerobic power variables. In addition, no significant differences were observed in blood lactate concentration (table III).

Table II
Anaerobic power by Wingate test

		Treatment [Mdn (IqR)]	
	Trial	*Placebo*	*Creatine*
Maximum anaerobic power (W)	Baseline	518.7 (427.4 to 572.3)	473.6 (426.9 to 583.9)
	Final	601.1 (448.0 to 637.4)	590.7 (464.6 to 694.5)
	Δ	40.7 (13.96 to 62.77)	51.9 (19.58 to 171.62)
Maximum anaerobic power (W/kg of BM)	Baseline	7.28 (6.94 to 8.53)	6.99 (6.16 to 7.87)
	Final	8.13 (7.41 to 9.21)	8.09 (6.42 to 10.36)
	Δ	0.55 (0.08 to 1.25)	0.67 (0.07 to 2.23)
Medium anaerobic power (W)	Baseline	449.5 (364.45 to 499.13)	401.6 (383.09 to 500.95)
	Final	520.3 (404.29 to 541.53)	480.0 (420.72 to 580.58)
	Δ	34.5 (16.41 to 57.82)	44.7 (14.44 to 148.11)
Medium anaerobic power (W/kg of BM)	Baseline	6.31 (5.76 to 7.50)	5.96 (5.66 to 6.68)
	Final	7.06 (6.47 to 7.77)	6.65 (5.94 to 8.81)
	Δ	0.61 (0.06 to 0.94)	0.54 (0.21 to 2.05)
Fatigue index (%)	Baseline	28.99 (24.23 to 33.05)	27.25 (22.42 to 35.24)
	Final	33.33 (27.33 to 36.61)	32.56 (26.04 to 37.82)
	Δ	3.87 (-2.97 to 9.88)	2.89 (-5.49 to 11.39)

Data are *Mdn (IqR)* = Median (Interquartile Range [percentile 25th to 75th]) from n = 10 subjects; Δ = Final-Baseline; *p < 0.05 *vs.* placebo from Wilcoxon signed-rank tests.

Table III
Blood lactate concentration after 5 min of recovery from the Wingate test, and blood chemistry

		Treatment [Mdn (IqR)]	
	Trial	*Placebo*	*Creatine*
Blood lactate (mmol/L)	Baseline	7.16 (4.70 to 9.78)	8.26 (7.00 to 8.95)
	Final	12.16 (10.35 to 14.20)	9.33 (6.85 to 11.00)
	Δ	5.00 (3.48 to 7.99)	0.45 (-1.51 to 3.85)
Glucose (mg/dL)	Baseline	83.50 (77.00 to 88.50)	83.50 (82.75 to 88.25)
	Final	84.50 (82.50 to 88.50)	88.00 (84.00 to 95.00)
	Δ	1.50 (-1.75 to 6.50)	4.00 (-2.00 to 9.50)
Urea (mg/L)	Baseline	38.50 (29.00 to 42.75)	29.50 (26.00 to 42.25)
	Final	37.00 (29.00 to 41.75)	34.50 (32.25 to 37.00)
	Δ	-0.50 (-6.75 to 3.25)	2.50 (-7.50 to 9.00)
Serum creatinine (mg/L)	Baseline	1.11 (1.02 to 1.16)	1.09 (1.01 to 1.20)
	Final	1.10 (0.99 to 1.20)	1.21 (1.06 to 1.37)
	Δ	-0.04 (-0.07 to 0.08)	0.11 (0.02 to 0.23)
Total cholesterol (mg/L)	Baseline	157.5 (122.00 to 190.75)	166.0 (143.00 to 185.75)
	Final	169.5 (124.75 to 194.50)	171.5 (134.50 to 187.50)
	Δ	6.0 (-7.50 to 13.50)	-1.5 (-10.25 to 8.25)
Triglycerides (mg/L)	Baseline	67.50 (52.00 to 94.25)	73.50 (46.75 to 111.50)
	Final	62.00 (44.25 to 109.25)	105.50 (68.50 to 157.25)
	Δ	-7.00 (-10.75 to 12.00)	45.00 (-7.50 to 75.00)*

Data are *Mdn (IqR)* = Median (Interquartile Range [percentile 25th to 75th]) from n = 10 subjects; Δ = Final-Baseline; *p < 0.05 *vs.* placebo from Wilcoxon signed-rank tests.

Blood chemistry

All evaluated blood chemistry parameters were within normal reference values for healthy Mexican people. A significant difference (Z = 2.090, p < 0.037, r = 0.47) between treatments was found in triglycerides concentration (table III). Comparing results for each subject, we observed that 7 subjects had an increase in triglycerides after Cr supplementation, 2 had a decrease, and one maintained the

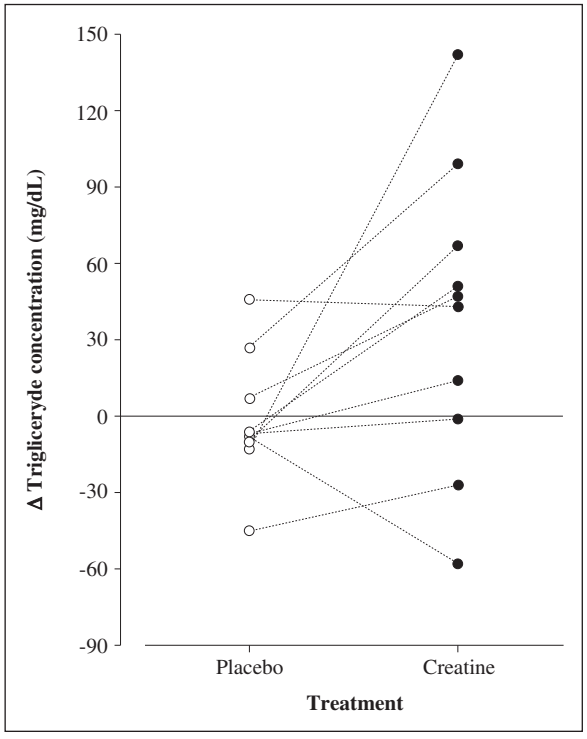

Fig. 4.—Individual differences in triglyceride concentration.

same level (fig. 4); whereas, after placebo supplementation 7 decreased and 3 increased triglycerides concentration (fig. 4). No significant changes were found for glucose, urea, serum creatinine, and total cholesterol. Moreover, no significant differences in serum liver enzymes were found after Cr supplementation (table IV).

Discussion

We studied the effect of oral Cr supplementation (50 mg/kg body weight for six weeks) on body composition, anaerobic power and blood chemistry of young male TKD practitioners. To our knowledge, this is the first study that evaluates Cr supplementation in TKD. Our results indicate that: (a) after Cr supplementation fat mass increased whereas it decreased after placebo; (b) there was an increase in serum triglycerides concentration after Cr; whereas after placebo it decreased; (c) not changes were found in anaerobic power; and (d) there were no changes in liver enzymes after Cr supplementation.

At the end of placebo supplementation FM decreased; but, after Cr ingestion it increased. It has been previously reported that, in healthy active men implementing a strength training program, Cr supplementation (20 g/day for 4 days, then 2g/day for another 17 days) prevents FM and BF% decrease, and results in an increased respiratory exchange ratio and carbohydrate utilization.[22] Therefore, Cr supplementation may inhibit normal fat loss through a greater carbohydrate oxidation and lower fat oxidation. Similar result have been reported after the ingestion of a supplement containing Cr (Cr [5 g], glutamine [3 g], and ribose [2 g] plus supplement base formula) and eight weeks of a resistance training program; in this research subjects decreased FM and BF% after placebo ingestion with an absence of changes after Cr ingestion.[23]

Furthermore, in a study with obese subjects,[24] researchers reported that simultaneous treatment with N-acetylcysteine (0.6 g) plus Cr (2 g) induces a reduction of ~2.2% in body fat mass; whereas subjects with only N-acetylcisteine (0.6 g) had a reduction of ~3.6%; and

Table IV
Blood enzyme concentrations

		Treatment [Mdn (IqR)]	
	Trial	*Placebo*	*Creatine*
Alanine aminetransferase (IU/L)	Baseline	24.50 (17.50 to 29.75)	28.0 (17.25 to 36.25)
	Final	33.00 (19.75 to 52.75)	21.00 (18.25 to 26.25)
	Δ	5.00 (-2.75 to 25.00)	-3.00 (-6.50 to 1.25)
Aspartate aminetransferase (IU/L)	Baseline	26.50 (24.75 to 34.50)	30.50 (25.00 to 33.75)
	Final	30.50 (25.25 to 37.25)	30.50 (27.75 to 34.50)
	Δ	0.00 (-3.00 to 6.75)	0.50 (-6.25 to 7.25)
Gamma-glutamil transferase (IU/L)	Baseline	22.25 (16.58 to 24.18)	18.55 (15.23 to 25.15)
	Final	20.45 (16.40 to 36.90)	22.05 (14.32 to 26.65)
	Δ	-0.85 (-4.50 to 5.45)	1.15 (-1.9 to 3.8)
Lactate dehydrogenase (IU/L)	Baseline	365.5 (330.0 to 385.7)	373.5 (316.0 to 405.5)
	Final	363.5 (330.7 to 393.5)	376.5 (358.7 to 404.2)
	Δ	27.5 (-27.25 to 45.75)	-7.5 (-22.50 to 35.75)

Data are *Mdn (IqR)* = Median (Interquartile Range [percentile 25th to 75th]) from n = 10 subjects; Δ = Final-Baseline; *p < 0.05 *vs.* placebo from Wilcoxon signed-rank tests.

subjects with only Cr (2 g) had an increase of 2.3%. In addition, the reduction produced by N-acetylcisteine plus Cr was accompanied by a decrease in plasma glucose levels at 30, 60, and 90 min of oral glucose tolerance tests, and a significant decrease in insulin concentration 60 min after glucose administration.[24] Authors suggested that Cr improves muscular insulin reactivity and may reduce body fat without compromising glucose utilization. Although various previous studies have reported no significant changes in triglycerides concentration after Cr supplementation in resistance-trained men,[25] basketball player[26] and football players,[27] we observed a significant difference in triglycerides concentration after Cr supplementation compared with placebo in the final trial. It has been suggested that the increase in carbohydrate utilization induced by Cr may be due to an activation of the enzyme phosphofructokinase, which produce an increase in glucose utilization, with elevation of malonyl-CoA and inhibition of carnitine palmitoyltransferase 1 (CPT1) system, which transports fatty acids into the mitochondria for oxidation.[22] If fatty acids are not transported into the mitochondria of skeletal muscle cells to be oxidized, they could be expected to be maintained in blood as triglycerides; and then stored in the adipose tissue. We observed a higher concentration of triglycerides after Cr supplementation, and also found that subjects after Cr treatment gained fat mass whereas after placebo treatment fat was lost. Therefore, both findings could imply that fatty acid mitochondrial uptake has been inhibited by Cr ingestion, altering the normal fat loss produced by TKD training.

Previous studies have shown improvements in anaerobic power by Cr using a 30 s Wingate Test in elite wrestlers,[28] amateur swimmers,[29] untrained male university students[30] and trained young men.[20] We did not find significant differences in anaerobic power in our subjects, coinciding with reports in strength/power athletes using a daily supplementation of 10.5 g de Cr plus a resistance training program for 10 weeks,[31] or healthy subjects receiving Cr (0.1 g/kg/day) during 10 days.[32] These mixed results indicate that the effectiveness of Cr supplementation on power is not always clear. Moreover, the presence of non-responders[33] may even complicate more the interpretation of results in studies involving a low number of subjects. Then, although the slight increase (0.17 kg) in body fat of our TKD practitioners may be beneficial for practitioners and athletes who are in their desirable body weight; TKD practitioner using it as a fitness program or TKD athletes who are losing weight may have problems to decrease body fat mass. Moreover, during TKD competitions, athletes are divided in weight categories, and practitioners are required to make weight to compete. Then, on the one hand, Cr supplementation could help to maintain the desirable weight in TKD competitors during preparation; but, on the other hand, TKD practitioners who are losing weight should be careful to take Cr supplementation due to a the possibly fat retention.

Finally, in agreement with different previous studies, no increase in the activity of any liver enzyme was found following Cr supplementation.[34,35] We were not able to find studies reporting the activity of serum enzymes in TKD players, being the present the first report on the safety of low doses of Cr supplementation in this sport.

Conclusion

In conclusion, oral creatine supplementation (50 m/kg of body mass for 6 weeks) could help to increase slightly fat mass in young male TKD practitioners, suggesting a change in substrate utilization as was shown by the increase in serum triglycerides, with no improve of anaerobic power. In addition, we did not found clinically significant changes in blood chemistry parameters, which suggest that Cr supplementation, at the dose used in the present study, appears to be safe for TKD practitioners, although they must be careful when fat loss is wanted.

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