CREATINE SUPPLEMENTATION FOR POST-EXERCISE MUSCLE DAMAGE

SUPLEMENTAÇÃO COM CREATINA PARA DANOS MUSCULARES PÓS-EXERCÍCIO

SUPLEMENTACIÓN CON CREATINA PARA DAÑOS MUSCULARES DESPUÉS DEL EJERCICIO

Review Article
Artigo de Revisão
Artículo de Revisión

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ABSTRACT

Introduction: Exercise-induced muscle damage (EIMD) can occur from recent or unusual physical activity, leading to a temporary reduction in muscle function. And increased pain. Several articles indicate the positive impacts of creatine on EIMD. Objective: Evaluate the impact of creatine on EIMD. Methods: Online searches were performed in Scopus, Embase, Medline and Google scholar until March 2022. Results: Thirteen studies met the inclusion criteria. To assess the quality of the studies, the Cochrane collaboration system was used for risk and bias analysis. Due to the high heterogeneity of interventions and studies designed, a meta-analysis was not performed. The current paper reveals that creatine intake is preferable to inactive recovery and only a rest period between several harmful and exhausting physical activities. Conclusion: Benefits were attenuated in EIMD markers that reduce muscle operation and muscle strength loss after exercise. ***Level of evidence II; Therapeutic studies - Manuscript review.***

Keywords: Creatine; Soft Tissue Injuries; Meta-Analysis; Creatine Kinase; L-Lactate Dehydrogenase.

RESUMO

Introdução: O dano muscular induzido pelo exercício (EIMD) pode acontecer por atividade física recente ou não habitual e leva a uma redução temporária da função muscular. e aumento da dor. Vários artigos indicam impactos positivos da creatina sobre a EIMD. Objetivo: Avaliar o impacto da creatina sobre a EIMD. Métodos: Foram feitas pesquisas eletrônicas em Scopus, Embase, Medline e Google scholar até março de 2022. Resultados: Treze estudos preencheram os critérios de inclusão. Para avaliar a qualidade dos estudos, o sistema de colaboração Cochrane foi utilizado na análise de risco e viés. Devido à alta heterogeneidade de intervenções e estudos desenhados, a meta-análise não foi realizada. As informações do documento atual revelam que a ingestão de creatina é preferível a uma recuperação inativa e apenas um período de repouso entre diversas atividades físicas prejudiciais e exaustivas. Conclusão: Os benefícios evidenciaram-se atenuados nos marcadores EIMD que reduzem a operação muscular e a perda de força muscular após os exercícios. ***Nível de evidência II; Estudos terapêuticos - Revisão de manuscritos.***

Descritores: *Creatina; Lesões dos Tecidos Moles; Metanálise; Creatina Quinase; L-Lactato Desidrogenase.*

RESUMEN

Introducción: el daño muscular inducido por el ejercicio (EIMD) puede producirse por una actividad física reciente o inusual y provoca una reducción temporal de la función muscular y un aumento del dolor. Varios artículos indican impactos positivos de la creatina en la EIMD. Objetivo: Evaluar el impacto de la creatina en la EIMD. Métodos: Se realizaron búsquedas electrónicas en Scopus, Embase, Medline y Google scholar hasta marzo de 2022. Resultados: Trece estudios cumplieron los criterios de inclusión. Para evaluar la calidad de los estudios, se utilizó el sistema de colaboración Cochrane para el análisis de riesgos y sesgos. Debido a la gran heterogeneidad de las intervenciones y de los estudios diseñados, no se realizó un metanálisis. La información del presente documento revela que la ingesta de creatina es preferible a una recuperación inactiva y sólo un período de descanso entre varias actividades físicas perjudiciales y agotadoras. Conclusión: Los beneficios se mostraron atenuados en los marcadores EIMD que reducen el funcionamiento muscular y la pérdida de fuerza muscular después del ejercicio. ***Nivel de evidencia II; Estudios terapéuticos - Revisión de manuscritos.***

Descriptores: *Creatina; Traumatismos de los Tejidos Blandos; Metaanálisis; Creatina Quinasa; L-Lactato Deshidrogenasa.*

DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0405 Article received on 06/23/2022 accepted on 10/05/2022

INTRODUCTION

Induced muscle-damage EIMD measuring directly comprises sub-cellular and cellular derivatives, specially Z-line streaming. This injury indicates itself as a increases in myoglobin, increases in indirect serum enzymes include creatine kinase (CK) and lactate dehydrogenase (LDH) level and delayed onset muscle soreness (DOMS).[1]

Because of EIMD and DOMS following eccentrically or intense exercise, a assaying the protocols that decrease mentioned unpleasant impacts should be followed. Newly, some papers showed that creatine supplementation might decrease post-exercise EIMD through mechanisms regulating stabilizing the sarcolemma and membrane permeability.[2]

Many persons have supplemented ergogenic aids to increase recovery post exercise. Therefore, the benefits of ergogenic supplements has always absorbed many researchers consideration for combination of exercise programmes and ergogenic supplements to improve the physical activity benefit.[3,4]

Studies evaluating the creatines consumption effects have proved reinforce performance in different exercise under a variety of testing situation,[5] however this has not been shown in all papers.[6]

Levels of endogen creatine in healthy individuals are normal range between 2.1 - 12 mg/L. Five gram oral dose in normal individuals leads to a high serum creatine concentrations of nearly 120 mg/L at 90 minutes after ingestion.[4]

Researchs have indicated that they have less creatines level in muscles or bloodstream, but not in brain. Also, there is evidence that supplementation with creatine may provide benefits for patients with diversity of neuromuscular diseases and metabolic disorders. Mentioned findings have showed that creatines administration can provides an ergogenic supplement for subjects and can provide several remedial benefit for specific individuals. Creatines aids are produces in monohydrate, gluconate,ethyl ester and nitrate types.[4]

In this work, all associated studies have been collected and the creatine efficacy on EIMD have been assessed.

METHODS

Searching

The systematic review done based on PRISMA checklist. The searching conducted up to May 2022 in Scopus, Library, Medline, Google Scholar and Cochrane.

Studies selection criteria

Studies elected applied items of PICOS comprising: 1) participant intaked creatines, as a supplement; 2) original RCTs; 3) at least one EIMD indices measures of CK and LDH; 4) reported EIMD markers information as mean ± SD in both intervention and control group.

Screening

Whole papers extracted from searching moved to EndNote X6 for checking. Studies analysed by two authors independently and elected according to selection items.

Quality of studies

The studies quality were assessed using the Cochrane Collaboration tool by following factors: generation of randomization sequence; concealment of allocation; participant and investigators blinding, commercial tendecy by company and attrition rate. An RCT ranked as comprising total unclear, high or low risk by the factors of blinding of participants and investigator, concealment of allocation and attrition rates reports.[7,8]

Load phases

An estimation of 0.30 gram/kg weight of body in 24 hours separated into four balance intervals had been purposed because creatines requires differ according to weight of body.[4] Mentioned increase in muscles creatines storages has been associated with ergogenic profits explained in the therapeutic use part. Although, more dosage for chronic period of times are being assayed to neutralize creatines deficiency and relieving disease.[9]

NutriGrade

With regards to creatines administration on CK and LDH level, total systematic review quality evaluated by NutriGrades scoring system. NutriGrade applies a rating system (0 to 10) to determine the meta-analysis quality performed in the nutrition field.[10]

RESULTS

Searching results

Results of electronic and manual search had 700 papers. After duplicates removing (n = 15), the title and abstract checking conducted on 685 related papers. Twenty papers remained after screening the criteria of inclusion and exclusion. At last, 15 papers were selected in the present review. Subjects tended to be young, but one article assessed creatine effects for youth men in addition to middle-aged men.[11] Furthermore, all subjects were men, except in one article which women participated (n = 15),[12] and in one article both women and men participated (n = 49).[13]

Table 1 shows the main features of the papers in present systematic review. In summary, the findings were onlined first between 1998 and 2018. The creatines impacts on both CK and LDH levels was evaluated in 9 articles[9,11,15-18] and 4 articles only reported CK.[12-14]

Eight effect sizes recorded <1 day follow-up;[12,13,16-20] seven effect sizes had 1 day follow-up;[9,15-17,21] nine effect sizes in 8 papers recorded

Table 1. Features of eligible articles.

Authors (y)	Studies Designation Features					Mean age (y)	Sampling		EIMD markers
	country	trained situation	creatine dosage(gram/d)	lenght (d)	sex		creatine	placebo	
Kreider et al. (1998)	USA	T	15.75	28	M	19.9	11	14	CK≡, LDH≡
Robinson et al. (2000)	UK	U	3	56	F	23.3	9	6	CK ≡
Rawson et al. (2001)	USA	U	20	5	M	26.9	12	11	CK ≡, LDH ≡
Kreider et al. (2003) *	USA	T	15.75	5	M	21	54	44	CK ≡, LDH ≡
Santos et al. (2004) *	Brazil	T	5	21	M	25.5	18	16	CK ≡, LDH ↓
Rawson et al. (2007)	USA	U	3	10	M	22.1	11	11	CK ≡, LDH ≡
Machado et al. (2009)	Brazil	U	40	5	M	21.2	15	12	CK ≡
Cooke et al. (2009)	Australia	U	21	5	M	22.1	7	7	CK ↓, LDH ≡
Rosene et al. (2009)	USA	U	6	30	M	21.6	10	10	CK ≡, LDH ≡
Bassit et al. (2010)	Brazil	T	20	5	M	37.5	4	4	CK ↓, LDH ↓
McKinnon et al. (2012)	Canada	U	40	5	M & F	20.6	9	9	CK ≡
Veggi et al. (2013)	Brazil	U	5	6	M	24.2	9	9	CK ↓
Cancela et al. (2015)	Uruguay	T	3	56	M	19.6	7	5	CK ≡
Wang et al. (2018)	Taiwan	T	20	28	M	20	15	15	CK ↓
Kaviani et al. (2018)	Canada	U	5	56	M	23	9	9	CK ≡, LDH ↓

CK = Creatine kinase; LDH = Lactate dehydrogenase; male; F = Female; D=Days; Y=years; T=trained; U= untrained. * Not randomized. ↓ Intervention group significantly lower compare to control group in any of follow up times; ≡ No significant difference between trials in any of follow up times.

2 days follow-up;[14-17,19,21] four effect sizes presented follow-ups at 3 days post exercise[11,15-17] and fourr effect sizes in 4 papers recorded follow-ups at 4 fays post exercise.[14-17]

Quality evaluation outcomes

The bias assessment quality presented in Table 2. Subjects random allocation was not reported in all studies except in 1 study that present the generation of random sequence process.[13] Most of papers reported low bias risk on selective reports; even so, 2 papers had high bias risk[12,16] and ulmost papers had unclear and high bias on participant and personnels blinding beside 1 paper which had low bias risk as to blinding of participants and personnel.[13]

NutriGrade

Total quality points of outcomes, that assessed by the NutriGrades scoring systems, were 5.2 in CK and 6.1 for LDH.

DISCUSSION

This work assessed indirect indices of EIMD, including CK and LDH among papers. Enzymes like CK and LDH have been widely used as EIMD indices and almost has been assessed to be an indirect biomarkers of after exercise EIMD because of their easy identification and low cost of tests and its quantification. Because CK and LDH rise after exercise being much variable and modified by exercise and individual items, the evaluation of pre- and post-exercise CK and LDH levels may presents a assessing tool for the EIMD determinatin, with less invasive pattern than required in a muscle biopsy.

Through time of elevated energy requirement, phosphagen apparatus quickly synthes ATP from ADP via phosphocreatine by a eversible reactions metabolized with CK enzymes. The phosphates groups is linked to a NH creatines center. In muscles, phosphocreatine level can touch 21 to 34 μM or much.

Levels of CK and LDH indices may be conditional on where EIMD occurs, the subjects situation of training and the adaptation with the activity used, and so the limitation of myocellular enzymes release. About this, most trials with untrain participant had a remarkable attenuation in CK levels with creatine consumption. The mean content of whole creatines (creatines and phosphocreatines) accumulated in body is around 110 mmol of evry kilograms muscles masses.

CONCLUSIONS

None of papers include in the systematic review blinded for providers and just a single article blind subjects. Because of the sport studies modality, in such surveys blinding may be challenging. Although, follow-up times after exercise discussed between-study heterogeneity, mainly for LDH level. The basic strength of the present systematic-review is evaluation of <1, 1, 2, 3 and 4 days follow-up times of EIMD indices post exercise. The second, we attempt to lessen every bias in this systematic-review procedure by conducting an extensive searching in databases plus conducting and elaborating the outcomes applying the PRISMA guidance.

All authors declare no potential conflict of interest related to this article

Table 2. Bias Evaluation Cochrane Risks.

Articles	Randomization Sequences Generation	Allocative concealments	Participants and personnel's blinding	Blinding's of outcomes evaluation	Incomplete outcomes information	Elective outcomes reporting's	Others source of bias	Total Bias Risk
Kreider et al. (1998)	U	U	U	H	L	L	L	moderate
Robinson et al. (2000)	U	U	U	H	L	H	L	moderate
Rawson et al. (2001)	U	U	U	H	L	L	L	moderate
Rawson et al. (2007)	U	U	U	H	L	L	L	moderate
Machado et al. (2009)	L	U	L	U	L	L	L	moderate
Cooke et al. (2009)	U	U	U	H	L	H	L	moderate
Rosene et al. (2009)	U	U	H	H	L	L	L	moderate
Bassit et al. (2010)	U	U	U	U	L	U	L	moderate
McKinnon et al. (2012)	U	U	H	H	L	L	L	moderate
Veggi et al. (2013)	U	U	H	H	L	U	L	moderate
Cancela et al. (2015)	U	U	H	H	L	L	L	moderate
Wang et al. (2018)	U	U	U	U	L	L	L	moderate
Kaviani et al. (2018)	U	U	U	U	L	L	L	moderate

L: low bias risks. H: high bias risks. M, moderate bias risks and U: unclear bias risks.

AUTHORS' CONTRIBUTIONS: The work is conceived and executed by Mingchuan Gao, analysis and manuscript writing done by Xiaodan Yang. Each author contributed in execution and writing of this manuscript.

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