INFLUENCE OF CREATINE KINASE ON C-REACTIVE PROTEIN IN MUSCLE ADAPTATION

INFLUÊNCIA DA CREATINA QUINASE SOBRE A PROTEÍNA C-REATIVA NA ADAPTAÇÃO MUSCULAR

INFLUENCIA DE LA CREATINA QUINASA SOBRE LA PROTEÍNA C-REATIVA EN LA ADAPTACIÓN MUSCULAR

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ABSTRACT

Introduction: Aging is a natural process and marked by changes and adaptations of both a biological and physiological nature. As regards adaptations, there are numerous works that address these responses following various types of training programs. Resistance training (RT) can be assessed by biochemical parameters such as creatine kinase (CK), which is a major marker of stress in the skeletal muscles. C-reactive protein (CRP) is a biochemical marker used to assess damage to the cardiac muscles. Objective: To evaluate the influence of CK on CRP in elderly female subjects undergoing RT. Methods: An experimental study was carried out with 10 elderly women (61 ± 1.8 years). Peripheral venous blood was collected for the CK and CRP analysis both before and 24 hours after 8 weeks of RT. Anthropometric measurements involved BMI (Body Mass Index), WHR (waist-to-hip ratio) and body composition. The RT involved combined series - Bi-Set. For statistical analysis, the Shapiro-Wilk normality test was conducted first and presented p > 0.05, confirming the use of parametric tests. Group variables were presented as mean and standard deviation. To compare the load-dependent samples, the repeated measures one-way ANOVA was performed first, followed by Tukey’s post hoc test. For CK and CRP variables, we conducted the paired Student’s t-test for the timepoints pre- and post-eight weeks of RT along with the one-way ANOVA test, also conducting Tukey’s post-test when necessary. The level of significance was set at p ≤ 0.05. Results: There was a statistically significant decrease in both serum CK and CRP, which indicated a reduction of 73.14% and 75%, respectively. Conclusion: Long-term RT promoted influences among biomarkers assessed through skeletal muscle (CK) and cardiac muscle (CRP) damage, determining adaptation and muscle remodeling in any age group. Level of evidence II, Investigation of treatment results.

Keywords: Creatine kinase; C-reactive protein; Myalgia; Aged.

RESUMO

Introdução: O envelhecimento é um processo natural e marcado por mudanças e adaptações, tanto biológicas quanto fisiológicas. Com relação às adaptações, existem inúmeros trabalhos que abordam essas respostas decorrentes de vários tipos de treinamento. O treinamento resistido (TR) pode ser avaliado por parâmetros bioquímicos, como a creatina quinase (CK), que é um grande marcador de estresse da musculatura esquelética. A proteína C-reativa (PCR) é um marcador bioquímico utilizado para avaliar o dano no sistema muscular cardíaco. Objetivo: Avaliar a influência da CK sob a PCR em idosas em TR. Métodos: Estudo do tipo experimental com dez idosas (61 ± 1,8 anos). As análises de CK e PCR foram coletadas em sangue venoso periférico antes e 24 horas após as 8 semanas de TR. Medidas antropométricas foram realizadas: índice de massa corporal (IMC), relação da cintura e o quadril (RCQ) e composição corporal. O TR foi realizado por série combinada (Bi-Set). Para análise estatística, primeiramente foi realizado o teste de normalidade de Shapiro-Wilk, apresentando p > 0,05 e comprovando a utilização de testes paramétricos. As variáveis do grupo foram apresentadas como média e desvio padrão. Para comparação das amostras dependentes de evolução das cargas foi realizado a ANOVA one-way para medidas repetidas, seguida de pós-teste de Tukey. Para variáveis de CK e PCR, foi realizado teste t de Student para os momentos pré e pós-8 semanas de TR, assim como o ANOVA one-way e, quando necessário, o pós-teste de Tukey. O nível de significância adotado foi de p ≤ 0,05. Resultados: Houve diminuição estatisticamente significativa, tanto para as concentrações séricas de CK, quanto para PCR, o que indicou redução de 73,14% e 75%, respectivamente. Conclusão: O TR de longa duração promoveu influências entre biomarcadores avaliados por meio do dano do músculo esquelético (CK) e dano do músculo cardíaco (PCR), determinando adaptação e remodelamento muscular em qualquer faixa etária. Nível de evidência II; Investigação dos resultados do tratamento.

Descritores: Creatina quinase; Proteína C-reativa; Mialgia; Idoso.

RESUMEN

Introducción: El envejecimiento es un proceso natural y marcado por cambios y adaptaciones, tanto biológicos como fisiológicos. Con respecto a las adaptaciones, existen innumerables trabajos que abordan esas respuestas derivadas de varios tipos de entrenamiento. El Entrenamiento Resistido (ER) puede ser evaluado por parámetros bioquímicos, como la creatina quinasa (CK) que es un gran marcador de estrés de la musculatura esquelética. La proteína C-reativa (PCR) es un marcador bioquímico utilizado para evaluar el daño en el sistema muscular cardíaco. Objetivo: Evaluar
INTRODUCTION

Aging is a natural process and marked by important changes in the body, with impairment in its mechanisms of adaptation, where they vary from individual to individual and depend on several factors, among them, the lifestyle that this individual follows interferes in the health / disease. In this adaptation process, both biological and physiological changes occur as a result of aging, with loss of biological repair capacity, including conditions that include weakness or deterioration of the body, influencing the appearance of various pathologies. For Antunes-Neto et al, these disorders caused by TR can be evaluated by biochemical parameters, among them creatine kinase (CK) being a great marker of skeletal muscle stress, resulting from the training performed, as well as a factor of control and monitoring of the training load. In this way, the more intense and prolonged the exercise, the greater the amount of muscular microleaders allowing the exit of this enzyme to the extracellular environment. Thus, the monitoring and behavior of CK concentrations has been increasingly used to determine the magnitude of the physical requirement imposed on the skeletal muscle system, as well as its adaptation to training.

While CK is the biochemical marker most commonly used in the literature to evaluate lesions caused in skeletal muscle cells, C-reactive protein (CRP) is a biochemical marker used to assess damage to the cardiac muscle system, where Mavros et al. and Santos et al. reported having an important role in the inflammation process of the cardiac muscle, since it is considered the main acute phase protein and synthesized from the influence of IL-6 under the hepatic system. Therefore, this marker has an important function, since it constitutes an inflammatory marker considered a strong independent predictor of risk for cardiovascular event and death caused by cardiovascular diseases.

Studies that measure the influence of markers of skeletal muscle modulation (CK) under the reduction of cardiac muscle tissue marker (CRP) through resistance training in the elderly are less common in the literature. Based on this, the study is justified in delving deeper into the subject in order to know better in what way these mechanisms happen.
whenever participants exceeded the limits of this zone, a new increase in load occurred to keep them within the zone established.

Increase of intensity (load-kg): two criteria were adopted: 1) To determine the load increase according to the intensity of effort reported by the participants, the Effort Perception Scale (BORG) was used; 2) All participants performed their RT program within a maximum repetition zone of eight to 12 repetitions, so that every time the participants exceeded the limits of this zone, a new increase in load occurred to keep it within the zone again established.

Time interval and duration of sessions: One minute rest was established between the segments worked and the average duration of 50 minutes per session.

Speed performed in the execution of the exercises: The duration speed of three seconds was respected for each movement, being 1.5 seconds for the concentric phase and 1.5 seconds for the eccentric phase, controlled by visual and verbal commands for standardization of the angulations of movement.9

Time of daily sessions: Average duration of 50 minutes per session.

Initially, the participants performed a week of familiarization with the TR, composed of two sets of 15 submaximal repetitions with the purpose of knowing the exercises and their respective executions and promoting neuromuscular adaptations, thus avoiding the excessive onset of Late Muscle Pain (DIMIT) to then start TR. Before and after all the training sessions, participants waited in the room for 5 minutes to measure their blood pressure to control vital patterns. The TR program was supervised and supervised by a Physiotherapist and two Physical Education Professionals.

In order to control anthropometric parameters and BMI, the following variables were measured: Body mass, height and BMI calculation were measured using the digital scale (Welmy*-W300, Brazil), with a maximum capacity of 300 kg. Waist and hip circumferences were then measured on a measuring tape of the brand (Waist Fit*, Brazil) in order to obtain data from WHR.

For the body composition, all the participants, prior to the measurements, were instructed not to feed two hours before the test, to not drink alcohol 24 hours before the test, not to drink alcoholic beverage and not to perform physical exercise 24 hours before the test, monitor fluid intake, and urinate 30 minutes prior to evaluation. The participants were then asked to lie down on the stretcher to fix the electrodes at the predetermined points and sanitize them with 70% liquid alcohol. The emitting electrodes were positioned at the following sites: the right hand and the right wrist and the other between the medial and lateral malleolus of the right ankle. This procedure was performed by means of a four-pole electric bioimpedance (Maltron BF-906 Body Fat Analyzer, Brazil).

The blood samples were taken by a trained phlebotomist, following the biosafety norms recommended by NR32, and they occurred in two moments: Pre (antecedent to TR) and Post (24 hours after the last resistance training), with the corresponding time interval to eight weeks between the two collections. The elderly women were instructed to attend the site in the morning and in a maximum fast of 12 hours. Blood samples were collected under vacuum with a volume of approximately 9 mL in a dry tube containing 5 mL of a clot-separating gel (Vacuette). After the blood sample was collected, the tubes were labeled and transported in hermetically sealed thermal boxes and sent to the Clinical Analysis Laboratory to be analyzed for Creatine Kinase (CK) and C-Reactive Protein (PCR).

Statistical analysis

Statistical analysis was performed using GraphPad Prism 6.0 software. First, the Shapiro-Wilk normality test was performed, presenting one (p> 0.05) proving the use of parametric tests. The variables of the group were presented as mean and standard deviation. To compare the load dependent samples, the One Way Test - ANOVA - paired for repeated measurements was performed, followed by Tukey post-test. For CK and PCR variables, the paired Student’s t test was performed for the pre and post eight weeks of RT, as well as the One Way RM-ANOVA test and, when necessary, Tukey’s post-test. The level of significance was set at p <0.05.

RESULTS

The sample was initially composed of 11 participants and completed after eight weeks with 10 participants. One obtained frequency less than 85% of the training sessions and was excluded. The characterization of the final sample can be seen in Table 1.

To control the evolution of the training load in the first, 4th and 8th weeks, the ANOVA test was performed for paired samples, followed by the Tukey post-test, showing a progression in their loads and in their respective exercises, showing a significant difference between all (p = 0.01 *), Table 2.

For the data of the serum concentration of CK the Student t test was used. Therefore, there was a statistically significant decrease when comparing the Pre 100.9 ± 45.80 U/L moment with the Post 27.1 ± 18.11 U/L (p <0.0001 *) moment, which represents a decrease of 73.14% in the serum concentration of CK shown in Figure 1.

For the serum concentrations of PCR the Student’s t-test was also used. We observed a statistically significant decrease when comparing the pre-dose 2.24 ± 1.43 mg/L with the post-dose 0.56 ± 0.41 mg/L (p <0.002 *), representing a 75% decrease in serum concentration of CRP shown in Figure 2.

The serum concentrations of CK and PCR for the ANOVA test. They are presented in Figure 3. We observed a statistically significant decrease between the Pre and Posttraining moments for both serum concentrations.

Table 1. Sample Characteristics.

| Variable          | n=10 |
|-------------------|------|
| Age (years)       | 61 ± 1.8 |
| Height (m)        | 1.54 ± 0.01 |
| Body Mass (kg)    | 68.08 ± 6.85 |
| Massa Gord (kg)   | 27.13 ± 4.39 |
| Lean Mass percentage (%) | 60.45 ± 2.36 |
| Fat percentage (%)| 39.55 ± 3.14 |
| BMI (kg/m²)       | 28.74 ± 2.64 |
| WHR (cm)          | 0.83 ± 0.06 |

Data are presented as mean ± standard deviation. BMI: Body Mass Index; WHR: Waist-to-Hip Ratio.

Table 2. Evolution of training load in first, fourth, and 8th-weeks of RT.

| Exercises | RT (n = 10) |
|-----------|-------------|
|           | 1st week | 4th week | 8th week | Effect size (Δ) | p Value |
| Seated Leg Press (Kg) | 20.7 ± 3.8 | 33.6 ± 1.1* | 45.48 ± 1.4* | 6.3 | 0.0001 |
| Elbow Extension (Low Pulley) (Kg) | 9.0 ± 1.8 | 13.8 ± 0.3* | 17.83 ± 0.4* | 4.8 | 0.0001 |
| Knee Extension (Kg) | 9.9 ± 0.5 | 18.4 ± 0.6* | 25.90 ± 0.8* | 28.0 | 0.0001 |
| Supine Seated (Kg) | 7.1 ± 0.3 | 13.8 ± 0.4* | 17.96 ± 0.7* | 29.2 | 0.0001 |
| Lying Knee Flexion (Kg) | 7.9 ± 0.4 | 15.5 ± 2.0* | 17.09 ± 0.5* | 22.1 | 0.0001 |
| Pulse (Kg) | 13.2 ± 0.5 | 21.9 ± 0.4* | 27.03 ± 0.5* | 26.4 | 0.0001 |
| Plantar Flexion (Seated Leg Press) (Kg) | 20.0 ± 0.7 | 33.38 ± 0.9* | 43.56 ± 1.2* | 30.9 | 0.0001 |
| Elbow Extension (Pulley) (Kg) | 8.6 ± 0.6 | 16.42 ± 0.4* | 20.20 ± 0.4* | 19.0 | 0.0001 |

Table 2. Evolution of training load in first, fourth, and 8th-weeks of RT.

Data presented as mean ± standard deviation. BMI: Body Mass Index; WHR: Waist-to-Hip Ratio.

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The objective of the study was to understand the events that influence Creatine Kinase (CK) in the modulation of C-reactive protein (CRP) inflammatory markers in the elderly through Resistance Training over eight weeks. The understanding of the findings allows us to observe the direct relationship between skeletal muscle adaptation assessed by CK and reduction of cardiac muscle injury marker through CRP.

**CONCLUSION**

Concluding with our results and from the results of other authors, Long-term Resistance Training will promote, in addition to other factors, influences between biomarkers evaluated through skeletal muscle damage (CK) and cardiac muscle damage (CRP) by determining adaptation and muscle remodeling in any age group.

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

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