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ASPIRIN MAY BE AN EFFECTIVE TREATMENT FOR EXERCISE-INDUCED MUSCLE SORENESS

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ABSTRACT
RIASATI, S.; MOGHADASI, M.; TORKFAR, A.; SHIRAZINEJAD, R.; ARVIN, H. Aspirin may be an effective treatment for exercise-induced muscle soreness. Brazilian Journal of Biomotricity, v. 4, n. 3, p. 206-213, 2010. Delayed onset muscle soreness (DOMS) refers to the skeletal muscle pain that is experienced following eccentric exercise. The aim of the present study was to examine the effect of aspirin supplementation on DOMS after an eccentric exercise. Sixteen healthy female [age, 21.05 ± 3.7 years; body mass index (BMI), 24.03 ± 0.8 kg/m²; (mean ± SD)] participated as subjects in this study. The subjects were assigned to either an experimental (200 mg of aspirin; n=8) or a placebo group (Same dosage of lactose; n=8) using a double-blind research design. Knee range of motion (ROM), perceived pain, thigh circumference and serum activity of the enzyme creatine kinase (CK) were taken before, immediately, 24 and 48 hours after the eccentric exercise. No differences among groups were observed for thigh circumference and ROM before, immediately, 24 and 48 hours after the eccentric exercise. Serum CK levels and pain increased (P<0.05) in the both groups immediately after the eccentric exercise and increased to maximum at 48 hours after the eccentric exercise. The aspirin supplementation decreased (P<0.05) the serum CK levels and pain compared to the placebo group at 24 and 48 hours after the eccentric exercise. In conclusion, aspirin supplementation can be effective to minimize DOMS induced by eccentric exercise.

Key words: Delayed onset muscle soreness, Aspirin, Creatine kinase.

INTRODUCTION
DOMS is the sensation of muscular discomfort and pain during active contractions that occurs in a delayed fashion after strenuous exercise (BYRNE and CLARKSON, 1986). Subjects with DOMS have painful, tender, and swollen muscles with reduced range of motion of adjacent joints especially after unaccustomed exercise (BARLAS et al., 2000; LIEBER and FRIDEN, 2002). In addition to muscle tenderness with palpation, prolonged strength loss and a reduced range of motion are observed (MERO et al., 2010). These symptoms develop 24 to 48 hours after exercise, and they disappear within 5 to 7 days.
The pathophysiology of DOMS remains still undetermined, but it has been reported that after strenuous exercise muscle cell damage and inflammatory cells are observed in damaged muscle (CHEUNG et al., 2003).

Although DOMS is not a serious condition and can be prevented by prior training (BYRNES et al., 1985), it may discourage further participation in exercise, and it is possible that muscle injury may result if heavy exercise is performed during the period of muscle weakness. No simple effective treatment is as yet available for DOMS. There is some evidence that DOMS may result from an inflammatory process which occurs in the muscle after exercise (HIKIDA et al., 1983; STAUBER et al., 1988). If this is the case, then it is possible that anti-inflammatory drugs may be effective in reducing DOMS and muscle damage; while, the majority of studies have found anti-inflammatory drugs such as ibuprofen (DONNELLY et al., 1990), prednisilone (HEADLEY et al., 1985), diclofenac (DONNELLY et al., 1988) and flurbiprofen (KUIPERS et al., 1985) to be ineffective in reducing DOMS. By our knowledge, attempts to determine aspirin effects on DOMS are very little. Aspirin (acetylsalicylic acid) is an over-the-counter non-steroidal anti-inflammatory drug now commonly used in the treatment of soft-tissue injuries (HERTEL, 1997). The aim of the study was to test the effects of aspirin on muscle soreness, muscle damage inferred from plasma enzyme activity changes and pain.

MATERIALS AND METHODS

Subjects

Sixteen healthy female with a mean (±SD) body mass index of 24.03 ± 0.8 kg/m², volunteered to participate in this study. The subjects were given both verbal and written instructions outlining the experimental procedure, and written informed consent was obtained. The study was approved by the Islamic Azad University Ethics Committee. The subjects were assigned to either an experimental (200 mg of aspirin; n=8) or a placebo group (Same dosage of lactose; n=8) using a double-blind research design. The subjects took 200 mg aspirin or placebo capsules immediately after an eccentric exercise. Both supplements were powders and powders were scaled and packed ready for the subjects in 1.5 ml Eppendorf tubes.

Anthropometric and body composition

Height, weight and lower leg length were measured, and body mass index (BMI) was calculated by dividing weight (kg) by height (m²). Thigh circumference was measured by using a Gulick anthropometric tape in the standing position. The tape was placed horizontally around the calf at the level of maximal circumference in a plane perpendicular to the long axis of the calf (MAUD and FOSTER, 2006).

Body composition was assessed via 3-site skinfold (triceps, suprailiac, and thigh) using Harpenden skinfold calipers (Harpenden, HSK-BI, British Indicators, West Sussex, UK). Body density was calculated from three-site skinfold using the Jackson and Pollock equation and percent body fat was calculated using the Siri equation (ACSM, 2005).

Range of motion (ROM)

Knee ROM was determined in the supine position, with the knee in full extension by using a Jamar goniometer. The stationary arm of the goniometer was aligned with the lateral midline of the thigh, using the greater trochanter as a reference point. The fulcrum was placed over the lateral epicondyle of the femur. The moving arm was aligned with the lateral of the fibula, using the lateral malleolus as a reference point. Knee flexion was
recorded as the movement of the lower leg from the neutral position to a position in which the lower leg and heel are maximally drawn toward the buttocks (MAUD and FOSTER, 2006).

**Eccentric exercise training**

Subjects stepped up on a bench set at 110% of their lower leg length. Exercise was continued for 10 minutes at a rate of one step per second. The order of steps was right leg up, left leg up, left leg down, right leg down. This regimen causes greatest soreness in the right thigh and left calf. If the subject failed to complete the exercise test, this was recorded.

**Nutrition**

Before the beginning of the study, each subject was supervised to continue his normal sport nutrition program. On the testing day the subjects were supervised not to use any sport or dietary supplements. They were supervised also to keep food diaries for seven days in the 2-week period for what they were provided with specific verbal and written instructions and procedures for reporting detailed dietary intake, including how to record portions by using household measures, exact brand names and preparation techniques. The nutrient composition was determined by a computer nutritional analysis program (COMP-EAT 4.0 National Analysis System, London, UK) using the McCance and Widdowson Food Composition Tables (PAUL and SOUTHGATE, 1978).

**Blood sampling**

Blood samples were taken from an antecubital vein in the sitting position. Ten milliliters blood from a vein was taken pre- and post-exercise, and at 24 and 48 hours after the eccentric exercise. Serum was separated and frozen at -20°C prior to analysis. CK was measured on a Technicon RA 1000 (Technicon Ltd, Basingstoke, UK) random access analyser, using a Technicon test kit.

**Score of muscle soreness and pain**

After the bench stepping exercise, each subject was given an outcome form, which they were asked to complete at specified times, immediately, 24 and 48 hours after exercise. The outcome form consisted of a Likert scale as described by High et al. (Figure 1). The outcome was the mean score of soreness and pain over the tree period.

Please tick the sentence below that best describes your level of muscle soreness over the past 12 hours.

- [ ] A complete absence of soreness
- [ ] 1 A light pain felt only when touched/a vague ache
- [ ] 2 A moderate pain felt only when touched/a slight persistent pain
- [ ] 3 A light pain when walking up or down stairs
- [ ] 4 A light pain when walking on a flat surface/painful
- [ ] 5 A moderate pain, stiffness or weakness when walking/very painful
- [ ] 6 A severe pain that limits my ability to move

**Figure 1 - Likert scale of muscle soreness (taken from High et al. 1989).**

**Statistical analysis**

Results were expressed as the mean ± SD and distributions of all variables were assessed for normality. 2 × 4 repeated measures of ANOVA test was used to evaluate time-course
change in variables. Post hoc analyses (Bonferroni) were then performed when warranted. The level of significance in all statistical analyses was set at \( P \leq 0.05 \). Data analysis was performed using SPSS software for windows (version 13, SPSS, Inc., Chicago, IL).

RESULTS

Physical and physiological characteristics of the subjects are presented in Table 1. No significant differences in any of variables were observed among the two groups. The Thigh circumference and knee ROM before and after the eccentric exercise are presented in Table 2. The results showed that the thigh circumference and knee ROM had not significant change before and after the eccentric exercise and no significant differences were observed among the two groups. Serum activities of CK increased after the eccentric exercise in the both groups (\( P<0.05 \)). The results showed that the serum CK levels increased in the both groups immediately after the eccentric exercise and increased to maximum at 48 hours after the eccentric exercise (\( P<0.05 \); Figure 2). The aspirin supplementation decreased (\( P<0.05 \)) the serum CK levels compare to the placebo group at 24 and 48 hours after the eccentric exercise. The results showed that the mean score of muscle soreness and pain decreased (\( P<0.05 \)) in the experimental group compare to the placebo group at 24 and 48 hours after the eccentric exercise (Table 3).

| Table 1 - Physical and physiological characteristics (mean ± SD) of the subjects |
|---------------------------------|-----------------|-----------------|
|                                  | Aspirin         | Placebo         |
| Age (yr)                        | 20.9 ± 3.8      | 21.2 ± 3.6      |
| Height (cm)                     | 168.2 ± 8.3     | 165.08 ± 10.1   |
| Body weight (kg)                | 68.3 ± 6.05     | 64.9 ± 6.3      |
| BMI (kg/m\(^2\))                | 24.11 ± 0.6     | 23.86 ± 0.8     |
| Body fat (%)                    | 20.2 ± 4.1      | 21.7 ± 3.4      |

<table>
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<th>Table 2 - Thigh circumference and knee ROM (mean ± SD)</th>
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<tr>
<td>Thigh circumference (cm)</td>
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<td>Knee ROM ((^\circ))</td>
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**DISCUSSION**

Exercise that results in the development of soreness is associated with the rapid destruction of muscle tissue (FRIDEN et al., 1983). DOMS is a familiar experience for the elite or novice athlete. Eccentric activities induce micro-injury at a greater frequency and severity than other types of muscle actions (BYRNES and CLARKSON, 1986). Up to six hypothesized theories have been proposed for the mechanism of DOMS, namely: lactic acid, muscle spasm, connective tissue damage, muscle damage, enzyme efflux and the inflammation theories (CHEUNG et al., 2003). The inflammation mechanism is not as well understood, but free radical initiated damage or release of pro-inflammatory substances has been implicated. The tissue injury appears to initiate an inflammatory response resulting in a release of cytokines, localized edema due to the migration of monocytes, macrophages, PGE2, histamines, etc., and increased blood flow and tissue permeability. The increase in edema and release of the prostaglandins and histamine may contribute to the pain sensation. The next series of events is the formation of proteases, phospholipases, and free radicals, which may lead to additional muscle tissue breakdown and pain. The last stage of events may result in a protective remodeling of the muscle to prevent muscle soreness with repeated or subsequent exercise (ARMSTRONG, 1990; CLARKSON and NEWMAN, 1995; MACINTYRE et al., 1995). Therefore, the inflammatory response may be responsible for the initiation, amplification, and/or resolution of the skeletal muscle injury.

A number of treatment strategies have been introduced to help alleviate the severity of DOMS and to restore the maximal function of the muscles as rapidly as possible. Non-
Steroidal anti-inflammatory drugs have demonstrated dosage-dependent effects that may also be influenced by the time of administration (Cheung et al., 2003). Aspirin is in a group of drugs called salicylates and it is used to treat mild to moderate pain, and also to reduce fever or inflammation (Herrel, 1997). It is evident from the results of this study that aspirin at this dosage is effective in ameliorating DOMS after the eccentric exercise. Hamberg found that therapeutic doses of indomethacin, aspirin and sodium salicylate do suppress prostaglandin synthesis. Bansil et al reported that aspirin (3g/d) delayed the appearance of DOMS by 12 to 24 hours. Francis and Hoobler, also, found aspirin effective in inhibiting prostaglandin synthesis and release. Aspirin blocks the synthesis of all pro-inflammatory prostaglandins and anti-inflammatory prostaglandins. As Taussig reports, aspirin inhibits all pro-inflammatory prostaglandin biosynthesis.

CK has commonly been used as an indicator of muscle injury (Sorichter et al., 1999). The results showed that the serum CK levels increased in the both groups immediately after the eccentric exercise and increased to maximum at 48 hours after the eccentric exercise. The aspirin supplementation decreased (P<0.05) the serum CK levels compare to the placebo group at 24 and 48 hours after the eccentric exercise. On the other hand, the mean score of muscle soreness and pain decreased (P<0.05) in the experimental group compare to the placebo group at 24 and 48 hours after the eccentric exercise. Thus it seems that the aspirin supplementation may effective in decrease the serum CK levels and muscle soreness and pain.

CONCLUSIONS AND PRACTICAL APPLICATION

Eccentric exercise has been shown to produce muscle cellular damage and decrements in motor performance as well. These findings suggested that aspirin supplementation may effective treatment for DOMS and exercise induced muscle soreness.

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