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# The effects of caffeine on perceived pain of muscles

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## ABSTRACT

*Pain of muscles usually occurs after doing a new unusual physical activity, especially when associated with repeated eccentric contraction and then it gradually disappear. There is not an extensive agreement in the case of treatment methods of soreness sings quick reduction. This research with the aim of reviewing the effects of caffeine in 5 stages (24h before exercise, 12h before exercise, after exercise and 12h after it) and 1mg per 1kg of body weight on reduction of perceived pain on muscles, studied 16 female volleyball player with the mean age of  $22 \pm 2/5$  years old in two caffeine and control groups. Amount of perceived pain was evaluated and compared in 2 groups. The result showed that caffeine is relatively effective in decreasing perceived pain muscles. It seems that coffee drinking causes decrease in pain. So suggested, athletes use this way for decreasing muscles perceived pain after the acute activity.*

**Key words:** muscle pain, caffeine, eccentric contraction.

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## INTRODUCTION

Muscle soreness and muscular pain are prevalent experiences after physical activities which are along with movement limitation, muscular tension, pain, inflation, diminishing and infinity of operational strength [8, 5, 2, 1]. On the whole, according to the time of muscular soreness, we can point to two kinds of soreness, delayed onset muscle soreness (DOMS) and acute muscle soreness. DOMS is felt from a few hours to some days after one session of active exercise. Most of people who do new and hard physical activities, experience DOMS somehow. This delayed pain starts around 8 hours after exercise and after damaging, it gradually reaches to its peak within 24 to 48 hours [1]. The pain arising from DOMS would be disappear after 5 to 7 days pain, soreness, tension, unusual sensitivity and are signs of this phenomenon [20, 16, 12, 11]. There are variety of opinions related to why muscular soreness is along with signs such as pain and obstruction; some experts believe that pain is the result of a leap which is produced after releasing proteins, ions, and extra cellular water in muscular myofibrious. Some also state that feeling of pain is arised by releasing biochemical materials from damaged cells and inciting the

chemical receivers [16]. Some researchers believe that muscular soreness is resulted from appearance of inflammation reactions in muscles [23]. This phenomenon causes operational diminishing in routine daily activities, it also binds operation of participants of sport matches and reduces their competency in later matches.

Sometimes the pain and neurotic strain arising from it would transfer to the other members of the family, the team and the coach and would have negative psychological effects on their operation and ability it also may hinder start and continuance of a sportive schedule and may destroy the individual tendency toward doing sport therapy during therapy period. Concerns of physicians, sport coaches, physiotherapists and other specialists of sport are about pain and, probably, threatening factors arising from it, falling of strength and movement extent, surplus gathering, inflammation and enzyme increase and caused them to think about prevention or reduction of DOMS effects at least possible time. Effective and helpful ways of therapy increase athlete's sportive operations and would accelerate restoration of nonathletic people to their normal life hither to, different kinds of solutions have been suggested to diminish or reduce the troubles of this impairment which include a broad spectrum of theatrical ways like, variety of thermotherapy, cryotherapy, massage therapy, electrical stimulation, pharmacotherapy, oxygen therapy, monotherapy and so on [8]. Principle of prescribing this ways depends on various reasons which one of them is preventing the start of impairment signs including release of muscular enzymes in blood, early elision of surpluses after exercise, reduction of pain, and increase of individual tolerance of pain. Therefor this way aims to reduce signs arising from this impairment, but, none of these ways could heal pains of delayed onset muscle soreness. So some researches have done researches about the effect of caffeine on reducing the pain of muscular damages.

Caffeine exists in Alkaloids such as tea, coffee, chocolate, and also some drinking like Cola [22, 16, 14]. It's effects on mobility generating on brain and muscles have been proved; the caffeine which exists in coffee is also sedative for muscles, improves body standing during hard sportive exercises, and removes, muscles fatigue [9, 10]. Caffeine, because of its role in haltering receivers related to Adenosine in brain, is effective in reducing pain [21]. Adenosine is a molecule which is produced in brain and when its level increased to the needed point, it would join to the Adenosine receivers of the brain. This connection can also cause fatigue, pain and sleepiness in person, widening brain's blood veins, and increase of oxygen transition to brain cells in time of sleep. The more Adenosine jointment to brain Adenosine receivers, the more fatigue, pain, and sleepiness in person [17, 13, 6]. Adenosine exert also in fact reaction to injury and activates pain receivers in body cells [15]. Increase of free Adenosine causes vein widening in muscles and blood circulation increase and, in this way, it causes propel of pain factors and increased enzymes during injury [24]. So caffeine with this ability in increasing calcium release form reticulum sarcoplasmic can improve muscular power and strength though low level of PH in muscles [24]. Maridakis (2006) in her study on a woman about effects of caffeine on delayed onset muscle soreness indicated that caffeine can help sedation of delayed pain [19]. The pain, in this research, has been analyzed as the only sign of delayed pain. In this manner, too much negative impairments have been set forth about excessive consuming of caffeine which are: anxiety, palpitation, blood pressure increase, urine increase, and sleep disorder [7, 19].

Considering the scanty of researches related to the effect of caffeine on delayed onset muscle soreness, necessity of such studies would be clear. In the only research related to the effect caffeine consumption on delayed onset muscle soreness had been used of caffeine tablet but in this research has paid attention to the analysis of coffee's caffeine effects on delay onset muscle soreness. With no doubt, people have less negative reaction against using coffee than drugs. In this research the effect of 1mg of caffeine per 1kg of body weight on different factors have been

studied on degree of pain in subjects prime legs after delayed onset muscle soreness. Which have been done in 5 levels (24 hours before, 12 hours before, exactly after and 12 hours after exercise).

## MATERIALS AND METHODS

In this semi\_experimental research, 16 female volleyball players were chosen and answered a questionnaire about individual characteristics and their health state voluntarily. Tests were done in 2 eight- member homogeneous groups , control and experimental groups, with the mean age of  $22 \pm 2/5$  years old, the mean height of  $163 \pm 0.5$  and the mean weight of  $53.5 \pm 0.8$  , without any other heart – blood and neu-muscular diseases and with at least one year regular experience in weekly exercises , excess to their routine activities, at least one week before and 24 hours after the test. Moreover, according to list of food which were provided by the researcher, they should have avoided foods and drugs which have caffeine and Anodynes. 12 to 24 hours before exercise starts, each subjects of experimental group were given a cup of coffee containing 1 mg of caffeine per 1 kg of their body weight and subjects of control group were given a cup of brown placebo like drinking. Before starting the exercise and after measuring height, weight and blood samples for assigning initial degree of Creatinekinse enzyme of blood serum, subjects of the two groups were given a questionnaire of pain perception and according to the pain on prim groin, they drawn a protracted line which has been graded from 0 to 24 hours. After 10 minutes of general and exclusive warm-up, subjects were engaged to do 50 single jump over a plat form of 1 meter hight at 30 seconds regular intervals. It is necessary to mention that, causing muscular soreness of this method were proved by a pilot study 3 weeks before, immediately, and 12 hours after activities, both groups drunk the same again and after every stages, the mentioned factors were measured again. Afterwards, the subjects were asked to go home, do their routine activities, avoid using any sedative drugs, and after 24 hours, base on their time scheduals, they were asked to go to the gym to remeasure the mentioned activities. The third stage of measuring the factors was done, exactly, 24 hours after testing the subjects, it is worthy of mention that , of increase permanency of the fest, in each stage, factors were measured 3 times and their averages calculated. The resulted data from various tests were presented in special tables at different stages of researches, and then statistics analyses were done and research hypotheses were tested variability of dependent variables of two groups were analyzed in every stages for both groups by ANOVA and Tukey statistical ways, and were compared with other group by T-Student tests.

## RESULTS

**Table 1. Analysis of variance results in creatine kinaz enzyme's control group**

Variance	SS	Sum of Squares	F	Significant Level
SSb	10571.01	537.291	10.17	0.0001
SSw	10946.29	519.998		
Total	21517.83			

**Table 2. Tukey test results in creatine kinaz enzyme's control group**

	24h after independent variable	Exactly after independent variable	Exactly after exercise
Before exercise	† -52.01 ‡ 0.0001	-14.60 0.097	-14.62 0.147
Exactly after exercise	-67.62 0.049	-29.22 0.178	
Exactly after independent variable	-37.48 0.073		

‡ Statistical significance level

† Difference level

**Table 1. Analysis of variance results in creatine kinase enzyme's caffeine group**

Variance	SS	Sum of Squares	F	Significant Level
SSb	3831	1914.55	6.069	0.008
SSw	6635.655	317.780		
Total	10466.655			

**Table 2. Tukey test results in creatine kinase enzyme's caffeine group**

	24h after independent variable	Exactly after independent variable	Exactly after exercise
Before exercise	† -27.25 ‡ 0.007	36.15 0.117	-10.5 0.543
Exactly after exercise	-17.65 0.073	-26.43 0.334	
Exactly after independent variable	-9.12 0.187		

‡ Statistical significance level

† Difference level

**Table 3. Analysis of variance results in pain's control group**

Variance	SS	Sum of Squares	F	Significant Level
SSb	463.934	230.951	1417.61	0.0001
SSw	3.412	0.159		
Total	467.342			

**Table 4. Tukey test results in pain's control group**

	24h after independent variable	Exactly after independent variable	Exactly after exercise
Before exercise	† -11.522 ‡ 0.0001	-8.488 0.0001	-4.787 0.0001
Exactly after exercise	-6.996 0.0001	-3.411 0.0001	
Exactly after independent variable	-2.759 0.0001		

‡ Statistical significance level

† Difference level

**Table 7. Analysis of variance results in pain's caffeine group**

Variance	SS	Sum of Squares	F	Significant Level
SSb	3594.763	180.288	489.913	0.0001
SSw	7.118	0.358		
Total	367.475			

**Table 8. Tukey test results in pain's caffeine group**

	24h after independent variable	Exactly after independent variable	Exactly after exercise
Before exercise	† -9.529 ‡ 0.0001	-8.31 0.0001	-3.98 0.0001
Exactly after exercise	-6.502 0.0001	-5.68 0.0001	
Exactly after independent variable	-1.51 0.0001		

‡ Statistical significance level

† Difference level

As it is shown in table 1 and 2, enzymic variations was meaningful in both groups, before and 24 hours after applying in independent variable ( $p=0.029$ ). This means that caffeine consumption could control enzyme increase within next 24 hours (37.18 percent increase in comparison with 68.80 percent increase in control group). Moreover, in analyzing pain variations before exercise and 24 hours after applying independent variables, they observed a big difference in each stages of measurement ( $p=0.003$ ), which means that caffeine consumption had a big effect on variability of pain feeding after eccentric contractions.

## DISCUSSION

As mentioned before, muscles pain would happen usually after new and unusual physical activities, especially, when these exercises involve repeated, eccentric contractions [3, 4, 18, 20]. According to the fact that molecular structure of caffeine is similar to molecular structure of Adenosine, caffeine can join to receivers which are related to the brain. Adenosine and prevents Adenosine jointment to those receivers and can causes decrease in tiredness and pain feeling after muscular injuries [8, 14, 17, 19]. In this research, effect of coffee drinking in decreasing muscles pain, has been evaluated positive and meaningful. It seems that coffee drinking causes decrease in pain. Moreover with widening vessels arising from increase of free Adenosine and blood delivery to muscles, it causes better exertion of body surpluses. Results of this research were congenial with results of Maridakis one [19].

## CONCLUSION

Results of this research expressed that consuming 5mg of caffeine existing in coffee, per 1 kg of body weight, is effective in decreasing the signs of delayed onset muscle soreness from 24 hours before to 12 hours after DOMS. So it is suggested that physiotherapists, physicians, specialists of sport, and athletes use this method to bring DOMS to the minimum and afterwards to prevent decrease of athletes performance. Also, they can use this method to prevent disappointment of non-athletes after muscular soreness arising from hard damages. Of course, according to the negative impairments of excessive caffeine consumption on blood pressure, heart beat etc. It is better to avoid of excessive consumption of it.

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