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The Relationship Between Time of Onset and Duration of Delayed Onset of Muscle Soreness with the Intensity of Exercises Performed

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Abstract

Objective: Young athletes engage in strenuous physical activity to which they are unaccustomed, and usually land up in a phenomenon called Delayed Onset of Muscle Soreness (DOMS). This will decrease the performance of the athletes. There is a lack of consistency in the selection of duration and intensity of the exercise by athletes. There are dearth of studies which have been done on relationship between intensity and time duration of the onset of DOMS.

Methods: A convenience sample of 45 male subjects with the mean age of 24.8 ±1.1years and BMI of 23.4±2.3 participated in the study. Subjects were randomly allocated into three groups A, B and C (n=15) and was undergone a standard eccentric exercise protocol at three different intensities i.e. 75%, 50% and 25% of 1Repetition Maximum (RM) respectively. Study outcomes were measured by Visual Analogue Scale (VAS) to assess muscle soreness at time of onset of soreness (ToO) and three subsequent days (DoO). Total duration of the study per subject was for 5 days.

Results: All three groups showed occurrence of pain on post exercise, although group-C analysis showed non-significant result in the pain perception than group A and B ($p>0.05$). When compared the ToO and DoO between group A and B analysis showed non-significant whereas when between group A and B compared with group C showed significant result ($p<0.05$).

Conclusion: The result of the current study concluded that weight training for a beginner can safely start with 25% of 1RM intensity without anticipating of setting DOMS. Study also observed that higher intensity group will have faster onset and larger duration of DOMS than the other lower intensity groups.

Keywords: Muscle Soreness, Repetition Maximum, VAS, Intensity, Duration.

Introduction

The pain or discomfort in muscles that have undergone unaccustomed exercise, particularly exercise involving eccentric muscle actions is commonly called Delayed Onset Muscle Soreness (DOMS) [1,2]. It does occur any number of times throughout one's life [3]. Immediate soreness may be due to bio-mechanical end products of metabolism affecting nerve endings or temporary hypoxia due to muscle ischaemia. DOMS normally increases in the first 24 hours after exercise, peaks from 24-72 hours and then subsides so that by 5-7 days it is gone [4]. The severity of DOMS is variable, ranging from mild to extreme discomfort. Soreness that limits the use of muscle by reducing one's ability to produce force and by reducing ones relaxed joint angle. Eccentric exercise causes considerable morphological damage to the muscle fibres. In broad terms, this may be categorized as either mild or severe damage. The milder form is only seen with electron microscopy. Small areas of fibre

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Study Groups	ToO Mean±SD	DoO Mean±SD	VAS Mean±SD
Group-A	12.6±1.2	3.7±0.9	4.6±0.48
Group-B	14.6±1.2	1.7±0.7	2.8±0.5
Group-C	2.2±5.8	.13±0.3	0.1±0.3

Figure 1: Comparison of outcomes between groups

Between Groups	ToO		DoO		VAS	
	F-Value	p-Value	F-Value	p-Value	F-Value	p-Value
Group-AvsB	2	0.376	-1.933	0	-1.853	0
Group-AvsC	-10.4	0	-3.533	0	-4.526	0
Group-BvsC	-12.4	0	-1.6	0	-2.673	0

Figure 2: Between groups analysis

damage are seen immediately after exercise, they become more extensive over the next 2-3 days when there is distribution of the Z-line material distributed throughout the sarcomere. DOMS is reported to occur as consequences of eccentric muscle loading and manifests 24 hours after the exercise bout[5].

Fitzerald et al. (1991) suggested that exercise intensity rather than the mode of exercise determines the production of DOMS [6]. DOMS may result from as few as 15 repetitions or gentle eccentric loads for both in untrained subjects. Symptoms may last up to one week with many cases resolving within 72 hours [7]. A common response of performing unaccustomed or high intensity exercise is the occurrence of DOMS. Like muscle damage, DOMS results primarily from eccentric exercise, but subsequent eccentric bouts will diminish the DOMS response. However, soreness does not result from damage to the muscle fiber. Peak soreness occurs at 1-2 days post exercise while peak muscle damage is seen 3 days post exercise.

There is a lack of consistency in the selection of duration and intensity of the exercise by athletes. There are dearth of studies which have been done on relationship between intensity and time duration of the onset of DOMS. Purpose of the current study was to find out the time of onset and duration of DOMS with the different intensity of exercises.

Materials And Methods

A convenience sample of 45 male subjects with the mean age of 24.8 ±1.1years and BMI of 23.4±2.3 participated in the study. The study was approved by the university research ethics committee. All participants provided written informed consent. None of the subjects had performed weight training within last 6 months, or experienced pain in the arms, musculoskeletal injury, under any medication and only male subjects were selected in order to eliminate any potential gender related differences in perception of muscle soreness.

The Repetition Maximum (IRM) determined a week before the inducement of DOMS so that there may be no soreness additionally to the determination of IRM. After determination of IRM, the subjects were randomly divided into three groups A, B and C (n=15), and went through a standard eccentric exercise protocol at three different intensities i.e. 75%, 50% and 25% of 1RRM respectively. Repeated eccentric contractions were used to induce DOMS in the quadriceps muscle of the left lower extremity. The extensors were given eccentric contractions by making the subject sit in a quadriceps table with back and arms rested properly so that other part of the body could aid the extensor contraction of the participating leg and in each group, weight percentage equal to their respective group was used to perform eccentric contraction. Each subject performed only eccentric contraction by slowly lowering the weight from a fully extended knee position. The exercise consists of 6 sets of 10 eccentric contractions of Quadriceps muscle group. Each contraction lasted for 10 sec. with 20 sec inter trial rest. The 6 sets were each separated by 1 minute rest.

After the procedure, each subject was given Visual Analogue Scale (VAS) format and asked to note down the time of onset of soreness (ToO) and intensity of pain (VAS) each day until the soreness disappears (DoO). The VAS used in our study consisted of a continuous horizontal line- 100 mm in length, with anchor points of 'No pain' and 'Worst pain' at the left and right ends of the line respectively. An identical set of instruction was given to each subject prior to complete each VAS and subject indicated the amount of soreness by placing a slash. Relative soreness was then calculated by measuring the distance of the slash from the left end of the VAS. Time of onset of soreness (ToO) was the time elapsed after exercise at which point the subject experiences and intensity of pain and the total duration (DoO) the subject reported of soreness recorded each succeeding day continues until the pain disappears. Total duration of the study per subject was for 5 days.

Results

Data analysis was done by using the software package SPSS 16.0. The mean and standard deviation of all the variables were analyzed. Between groups analysis of outcome variables was done by one-way ANOVA.

Pain perception measured on VAS reported occurrence of pain in all three groups during study period. When the study groups were compared, group-C showed non-significant ($p>0.05$) in the ToO of pain perception than the other groups i.e. group A and B ($p<0.05$). Whereas DoO and VAS showed significant result between groups ($p<0.05$) (Table1.1; 1.2)

Discussion

The current study result showed that the 75% and 50% of 1RM intensity groups have the tendency to set DOMS in trained muscle group, whereas there was negligible amount of DOMS reported with 25% of 1RM intensity exercise group. Based on this observation it is assumed that weight training for a beginner can safely start with 25% of 1RM intensity without anticipation of setting DOMS. It is necessary for the selection of intensity and duration of exercise because studies have been reported that there is decrease in the performance of athletes once DOMS sets in. According to our knowledge, till now no studies have been done on the relationship between different intensities of resistance in exercise training which lead to DOMS.

It is well accepted that an eccentric component of training is effective for maximal gains in muscle strength and hypertrophy [8]. Present study also chose eccentric training to induce DOMS. However, studies have reported that acute eccentric muscle actions induce more severe muscle soreness, micro trauma and edema than concentric only contraction[9]. Because of this fear many researchers and clinicians still use concentric training for prepubescent children, older individual or patient recovering from surgery [10,11]. Thus, it is very necessary to choose appropriate intensity of eccentric training than concentric training. It has been reported that there are muscle fiber injuries after high tension anaerobic exercise and also observed that sports like weight lifting, sprinting etc. many of these activities consist of a large eccentric components [12]. However, our study result showed a safety selection of intensity of 25% of 1RM weight training is a bench mark for a beginner without anticipating of setting DOMS.

After eccentric training for 75% of 1RM, the onset of (ToO) DOMS set within 12.6 hours whereas in 50% of 1RM group it reported in 14.6 hours, however 25% of 1RM group had insignificant muscle soreness. Thus, the current result supported that the higher intensity group will have faster onset of DOMS than the other lower groups.

The duration of soreness (DoO) persisted after the ToO in 75% of 1RM and 50% of 1RM groups were for 3.7 and 1.7days respectively, whereas in 25% 1RM group not even induced soreness in 98% of the participated subjects. Thus, the current result supported that the higher intensity group will have larger duration of DOMS than the other lower groups.

Pain perception of DOMS measured by VAS score were 4.6 and 2.8 in 75% of 1RM and 50% of 1RM groups respectively, whereas in 25% 1RM group it was non-significant. The reliability of VAS on soreness have been proved by previous studies [13].

Rinard et al. (2000) observed the response of male and female to high form of eccentric exercise and reported that muscle damage in male and female showed a similar loss and recovery. The current study included only male subjects thus result of this study can be useful for both genders.

Future studies can be investigated on different intensities rather than 75%, 50% and 25 % of 1RM and observe its changes in muscle fiber level by advance technologies like MRI and detailed biochemical studies on blood samples.

Conclusion

It is concluded that weight training for a beginner must be start at 25% of 1RM intensity exercise programs, thus one can avoid the muscle soreness. Present study also observed that the higher intensity groups have faster, longer duration of DOMS during weight training. These observations can be applied during the selection and training of exercise programs.

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