

# Effectiveness Of Sub Maximal Eccentric Exercise Versus Moderate Intensity Aerobic Exercise To Reduce Doms As A Part Of Early Return To Strength Training

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## Abstract:

### Background:

While DOMS is not a disease or disorder, it can be painful and is a concern for athletes because it can limit further exercise in the days following an initial training. So the aim of the study is to compare the effectiveness of submaximal eccentric training and moderate intensity aerobic exercise to reduce DOMS.

### Materials and Methods:

In this prospective comparative study, 30 subjects with children with DOMS were randomly divided into 2 groups i.e. group A and group B with 15 subjects in each group. Group A was given submaximaleccentric exercise and group B was given Moderate Intensity Aerobic exercise and the effects of both the Pre and post treatments was measured with the outcome measures of VAS & LIKERT SCALE

### Results:

The data were analyzed using measures of paired *t*-test to find the significance of the interventions used among the groups. The analytical test showed significant reduces in DOMS for both the groups. SPSS formula was applied to data's of group.

### Conclusion:

The present Study stated that both, Submaximal Eccentric Exercise and Moderate Intensity Aerobic Exercise are proven effective to reduce DOMS, but Group received Submaximal Eccentric Exercise indicates more effectiveness in comparison with Group received Moderate Intensity Aerobic Exercise to reduce DOMS among strength trainers.

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## I. INTRODUCTION

The first detailed description of delayed onset muscle soreness (DOMS) was first given in 1902 by Theodore Hough. Delayed onset muscle soreness (DOMS) is muscle pain and discomfort experienced approximately one to three days after exercise. DOMS is thought to be a result of microscopic muscle fiber tears and is more common after eccentric exercise (the muscle must lengthen or remain the same length against a weight) rather than concentric exercise (the muscle can shorten against a weight load)<sup>1</sup>.

While DOMS is not a disease or disorder, it can be painful and is a concern for athletes because it can limit further exercise in the days following an initial training. Exercise-induced muscle soreness can be classified as either acute onset or delayed onset. Acute onset muscle soreness occurs during exercise and may last up to 4 to 6 hours before subsiding. Delayed onset muscle soreness (DOMS) has onset 8 to 24 hours post exercise, with soreness peaking 24 to 48 hours post exercise. Strenuous activity-especially eccentric exercise causes injury or trauma to the muscle, its musculotendinous junction, or both. Injury and/or trauma initiate an inflammatory response resulting in muscles feeling painful and swollen. Trauma results in significantly increased levels of muscle proteins and other breakdown products of muscle and collagen in the blood and/or urine. Pain is associated with decreased range of motion (ROM) and strength<sup>1</sup>.

After vigorous and unaccustomed resistance training or any form of muscular overexertion, delayed onset muscle soreness (DOMS), which is noticeable in the muscle belly or at the myotendinous junction, begins to develop approximately 12 to 24 hours after the cessation of exercise. The DOMS sensation usually intensifies and peaks 24 to 48 hours after exercise. Although the time course varies, the sign symptoms, which can last up to 10 to 14 days, gradually dissipate. Exercise-induced DOMS has been extensively studied in several skeletal muscle groups, but there are few studies on low back DOMS. Early season sports activities and physical work have induced low back DOMS, resulting in painful symptoms and deficits in back strength and range of motion

(ROM). Several modalities and medications have been used to prevent or to treat DOMS, but none has been shown to be clearly superior<sup>2</sup>. Kinematic analyses of running gait following DOMS inducement have revealed varied findings. Hamill et al. reported statistically significant differences in maximum ankle dorsiflexion and plantar flexion during the support phase, a reduction in maximum knee joint flexion in both swing and support phases, and a reduction in maximum hip flexion at touchdown in ten females following 30 minutes of downhill running. It was hypothesized that these changes were compensatory response to the reduced range of motion in the muscle group most affected by DOMS. The reduced ability of the knee and hip joints to attenuate shock was also thought to be compensated for by the ankle joint and was observed as increased dorsiflexion during support. Goff et al. used accelerometry data to report an increased attenuation of shock in the legs and a reduced attenuation at the head in nine male runners during level running 24-120 hours following 30 minutes of downhill running. The researchers attributed these findings to the body's ability to adapt and protect the leg from injury during running<sup>2</sup>. Significant reductions in strength and power parameters during DOMS have been documented by numerous researchers. These reductions are most notable in eccentric muscle actions, although concentric and isometric strength losses have also been reported. Peak torque deficits are most pronounced 24-48 hours following DOMS-inducing exercise and are more profound and persistent during eccentric testing. The duration of strength reduction is also greater following eccentric activity and may require up to 8-10 days to return to normal baseline levels<sup>3</sup>.

Eccentric exercises have been reported to be effective in reducing DOMS (1). American college of sports medicine has prescribed norms of eccentric exercises in preventing DOMS (2). The objective of present study was to evaluate role of submaximal eccentric exercises in reducing DOMS for male strength trainers<sup>3</sup>. The effect of low intensity vs. moderate intensity aerobic recovery on DOMS and strength.

Twenty-six women were split into 3 different groups and performed DOMS inducing protocol of 60 eccentric actions of knee extensors. The MIC and LIC groups performed 20 minutes of cycling at 80 rpm on a stationary cycle ergometer after testing day 1. The MIC group cycled at 70% age predicted maximum HR reserve while the LIC group cycled at 30% age predicted maximum HR reserve. Result moderate intensity aerobic recovery may be suggested after eccentric muscle actions<sup>4</sup>

**PROCEDURE**

Totally 38 subjects were assessed as DOMS by LIKERT scale for muscle soreness and VAS-numeric scale and oral complaint of the subjects. Out of 38 subjects 30 were selected and 8 excluded under the basis of selection of criteria. The subject was divided randomized into Group A (n=15) submaximal eccentric exercise and Group B (n=15) moderate intensity aerobic exercise. Pre -test and post-test of outcome measures are assessed as mentioned in above flow chart.

**Group A (SUBMAXIMAL ECCENTRIC EXERCISE)**

The subjects in this group were first selected under selection criteria and pre-test assessment was done by outcome measures VAS and LIKERT scale for muscle soreness. Then the subjects seated on quadriceps chair a manual strength training machine and 50 eccentric contractions of 80% 1RM for 5 sets of 10 repetitions were done using weights. Each set includes 10 contractions that lower a person's weight from (90 deg) knee extension starting position to full knee flexion as end position in 3 seconds and at least 2 seconds to reach the next contraction without weights placed in full extensions. One-minute rest was given between each set<sup>7</sup>. Post-test was assessed after 24 hours after the treatment.

**GROUP B (MODERATE INTENSITY AEROBIC EXERCISE)**

The subjects in this group were first selected under the basis of selection criteria pre-test was assessed by VAS and LIKERT scale for muscle soreness. Then the subjects seated on a stationary cycle ergometer. The subjects were asked to perform cycling for 20 minutes at 80rpm on a stationary cycle ergometer a manual machine<sup>4</sup>. Post-test was assessed after 24 hours after the treatment.

**STATISTICAL ANALYSIS**

**Table 1: Demographic details**

Variables	Group A	Group B
Age	20.2 ± 1.2	19.5 ± 0.6
Height	159.7 ± 7.7	159.3 ± 7.9
Weight	57.4 ± 7.8	56.9 ± 12.4
BMI	23.4 ± 4.4	23.4 ± 4.2
Total no of clients	T= 15	T=15

Paired t-test values

**Table: 2 within Group analysis VAS - Group A**

	GroupA	Mean	SD	t <sup>''</sup> value	p-value
VAS	Pre test	6.93	0.70	14.75	0.0001
	Post test	3.00	0.93		

**Paired t-test:** The p' value of VAS is 0.0001, considered extremely significant.  
The t'value of VAS is 14.75 with 14 degrees of freedom.

**Table: 3 within Group analysis VAS - Group B**

	GroupA	Mean	SD	t <sup>''</sup> value	p-value
VAS	Pre-test	7.53	0.64	4.5826	0.004
	Post test	6.53	0.52		

**Paired t-test:** The p' value of VAS is 0.004, significant. The t'value of VAS is 4.5826 with 14 degrees of freedom.

**Table: 4 within Group analysis LIKERT SCALE - Group A**

	GroupA	Mean	SD	t <sup>''</sup> value	p-value
LIKERT	Pre-test	4.80	0.68	19.34	0.0001
	Post test	2.00	0.76		

**Paired t-test:** The p' value of LIKERT is 0.0001, considered extremely significant.  
The t'value of LIKERT is 19.34 with 14 degrees of freedom.

**Table: 5 within Group analysis LIKERT SCALE- Group B**

	GroupA	Mean	SD	t <sup>''</sup> value	p-value
LIKERT	Pre-test	5.20	0.68	6.204	0.005
	Post test	3.73	0.80		

**Paired t-test:** The p' value of LIKEERT is 0.0005, significant. The t'value of LIKERT is 6.2048 with 14 degrees of freedom.

**Table: 6 Between Group analysis Group-A & B**

	GroupA	Mean	SD	t <sup>''</sup> value	p-value
VAS	A	3.87	0.99	8.9775	0.0001
	B	1.13	0.64		

**Un Paired t-test:** The p' value of VAS is <0.0001, considered extremely significant.  
The t'value of VAS is 8.9775 with 28 degrees of freedom.

**Table: 7 Between Group analysis Group-A& B**

	GroupA	Mean	SD	t <sup>''</sup> value	p-value
LIKERT	A	2.80	0.56	4.8105	0.0001
	B	1.47	0.92		

**Paired t-test:** The p' value of LIKERT is <0.0001, considered extremely significant.

The  $t$ -value of LIKERT is 4.8105 with 28 degrees of freedom.

## II. RESULT

Demographic details have been revealed in term of Mean  $\pm$  SD of age, height, weight, BMI and number of students as  $20.2 \pm 1.2$ ,  $159.7 \pm 7.7$ ,  $57.4 \pm 7.8$ ,  $23.4 \pm 4.4$  respectively (table 1). There was no significant difference hence baseline is comparable.

The data were analyzed using measures of paired  $t$ -test to find the significance of the interventions used among the groups. The analytical test showed significant reduces in DOMS for both the groups. SPSS formula was applied to data's of group.

In that group A showed significant improvement in reducing DOMS (VAS: pretest mean = 6.93; posttest mean = 3.00) and LIKERT scale of muscle soreness (pretest mean = 4.80, posttest mean = 2.00) than Group B (VAS: pretest mean = 7.53, posttest mean = 66.53 & LIKERT scale of muscle soreness (pretest mean = 5.20, posttest mean = 3.73). Group A showed a significant "P value < 0.0001 for VAS & scale.

### INTERPRETATION OF SCALES

#### INTERPRETATION OF VAS SCALE

The pre and post values of VAS between the group A and B is analyzed using unpaired  $t$ -test for 28 degree of freedom the group A mean value is 3.87 and SD value is 0.99 and group B mean value is 1.13 and SD value is 0.64 at 0.0001 significance, the  $t$ -table value is 2.074 and the calculated  $t$  value is 8.977. Since the calculated  $t$  value is greater than the table  $t$  value, hence between the groups shows extremely significant.

#### INTERPRETATION OF LIKERT SCALE OF MUSCLE SORENESS

The pre and post values of LIKERT scale of muscle soreness between the group A and B is analyzed using unpaired  $t$ -test for 28 degree of freedom the group A mean value is

2.80 and SD value is 0.56 and the group B mean value is 1.47 and SD value is 0.92 at 0.0001 significance, the  $t$ -table value is 2.074 and the calculated  $t$  value is 4.810. Since the calculated  $t$  value is greater than the table  $t$  value, hence between the groups shows extremely significant.

## III. DISCUSSION:

The purpose of the present study was to compare the effectiveness of the submaximal eccentric exercise versus maximal isometric contraction on DOMS among strength trainers. The result of the study demonstrated that group A (submaximal eccentric exercise) and group B (moderate intensity aerobic exercise) shows significant in reducing DOMS. In that group A little more effective than group A.

Thirty (30) participants with DOMS between the age group 18-30 were selected for this based on the inclusion and exclusion criteria. Out of 30 subjects, 15 subjects were grouped in submaximal eccentric exercise as Group A and 15 subjects were grouped in moderate intensity aerobic exercise as Group B. The outcome measures are Visual analogue scale (VAS) and LIKERT scale for muscle soreness are used as outcome measure.

The analysis of the obtained values, results statistically both the group was significant but when compared to moderate intensity aerobic exercise the group which received submaximal eccentric exercise has showed highly significant

This study which was done in 2015 compare the submaximal eccentric exercise versus maximal isometric contraction on DOMS. Sixty normal male volunteers were assigned randomly into three equal groups. . Group A (first study group) 20 subjects received submaximal eccentric contraction on non-dominant elbow flexors as a prophylactic exercise. Group B (second study group) 20 subjects received maximal isometric contractions on non-dominant elbow flexors as a prophylactic exercise. Group C (control group) did not receive any prophylactic exercises. Result both submaximal eccentric contractions and maximal isometric contractions were effective in prevention of DOMS. But the submaximal eccentric contraction produced greater protective effect against muscle damage. The result of study is similar to my where the submaximal eccentric exercise will reduce DOMS and also produce greater protective effect against muscle damage.

The purpose of this study was to investigate the effect of low intensity vs. moderate intensity aerobic recovery on DOMS and strength which was done in 2012. Twenty-six women were split into 3 different groups and performed DOMS inducing protocol of 60 eccentric actions of knee extensors. The MIC and LIC groups performed 20 minutes of cycling at 80 rpm on a stationary cycle ergometer after testing day 1. The MIC group cycled at 70% age predicted maximum HR reserve; while the LIC group cycled at 30% age predicted maximum HR reserve. The CON group was seated on the cycle ergometer for 20 minutes without pedaling the pedals parallel and the right foot in front. Result moderate intensity aerobic recovery may be suggested after eccentric muscle actions. The results of this study correlate with my study that the moderate intensity aerobic exercise can be given after the eccentric contractions of the muscle.

This study was done in 2012 where this study states about Delayed onset muscle soreness (DOMS) is

muscle pain and discomfort experienced approximately one to three days after exercise. DOMS is thought to be a result of microscopic muscle fiber tears and is more common after eccentric exercise (the muscle must lengthen or remain the same length against a weight) rather than concentric exercise (the muscle can shorten against a weight load). Management: Amir H Bakhtiary through their work concluded that vibration therapy before eccentric exercise may prevent and control DOMS, whereas Lori

A. Kuligowski, MS. et al concluded that cold whirlpool and contrast therapy are more effective than warm whirlpool or no treatment in alleviating delayed-onset muscle soreness in the elbow flexors However Zainal Zainuddin et al. concluded that massage was effective in alleviating DOMS approximately 30% and reducing swelling, but it had no effects on muscle function. Conclusion: In the aspect of treatment exercise works more effectively in reducing DOMS than heat, topical remedies containing methanols or camphor's, or anti-inflammatory drugs. The results of this study states that the exercise works more effectively in reducing DOMS where my study results that submaximal eccentric exercise will reduce DOMS effectively.

Stretching Before and After Exercise Studies were identified by searching MEDLINE (1966–February 2000). I searched the reference lists of identified studies manually until no further studies were identified. The search terms stretch, exercise, warm-up, and cool down were used in all databases except MEDLINE. Data extraction and assessment of study quality were well described. The principal outcome measures were measurements of muscle soreness and indices of injury risk. Results from the soreness studies were pooled by converting the numeric scores to percentages of the maximum possible score. These data were then reported as millimeters on a 100-mm visual analogue scale. With respect to risk of injury, the combined risk reduction of 5% indicates that the stretching protocols used in these studies do not meaningfully reduce lower extremity injury risk of army recruits undergoing military training. This study results that stretching of muscle will not reduce the lower extremity muscle injury.

#### IV. LIMITATIONS

- Small sampling was used in the study which questions the reliability and validity of the study techniques.
- Only males were used because of feasibility issues which makes it gender biased.
- Only clients below 30 years were considered so making the study contained to younger population alone.
- Study testing was confined to one group of muscles in lower limb alone.

#### RECOMMENDATION:

In future, study will be recommended conducting with more sample size, in different population with different outcome measure.

#### V. CONCLUSION:

Study stated that both, sub maximal Eccentric Exercise and Moderate Intensity Aerobic Exercise are proven effective to reduce DOMS, but Group received Sub maximal Eccentric Exercise indicates more effectiveness in comparison with Group received Moderate Intensity Aerobic Exercise to reduce DOMS among strength trainers.

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