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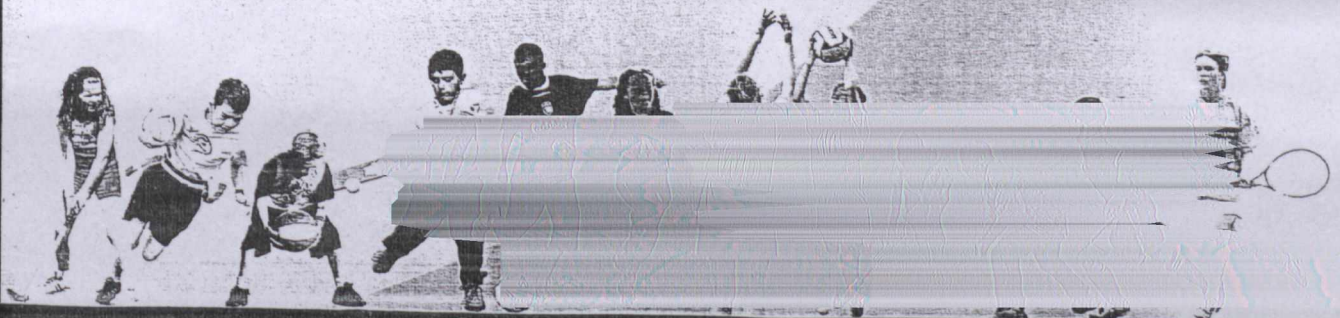
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## The Effect of 4-Week Leg Extension Training on The Strength of Quadriceps Muscles

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### Abstract

This study was conducted to identify the effect of 4-week leg extension training on the strength of quadriceps muscles. Thirty University of Malaya students ( $n = 30$ ) consisting of fourteen male ( $n = 14$ ) and sixteen female ( $n = 16$ ); (age  $M = 20.33 \pm 0.80$  years; height  $M = 165.93 \pm 8.75$  cm; weight  $M = 61.12 \pm 13.12$  kg) who were recruited by using the method of random sampling. These subjects were equally divided into two groups, the experimental group ( $n = 15$ ) and the control group ( $n = 15$ ) which respectively with a total of fifteen subjects (male = 7; female = 8) in each group. The experimental group carried out eight sessions of leg extension training. The 1 repetition maximum (1RM) of quadriceps muscles for both groups was obtained twice; pre-test and post-test. The results revealed that eight sessions of leg extension training induced significant improvement ( $t = 1.97$ ,  $df = 28$ ,  $p < .05$ ) on the strength of quadriceps muscles. However, the results also revealed that the control group did not show a significant difference in the strength of quadriceps muscles between pre and post intervention ( $t = 0.00$ ,  $df = 14$ ,  $p > .05$ ). These results suggest that the four week leg extension training is an effective and suitable method to improve the strength of quadriceps muscles.

Keywords: Leg Extension Training, Strength of Quadriceps, 1 Repetition Maximum (1RM)

### Introduction

Weight training refers to any type of training that involves the body moving in same direction against a force that resists that movement and is supplied by some type of weight including free weights and weight machines (Stoppani, 2006). Weight training using near one-repetition (1RM) weight at low velocity has been found to improve the muscle's ability to generate force, but the increase in strength may not be effective at velocities that stimulate the speed of sport performance (Cronin et al., 2003).

Leg extension exercise requires the use of a machine called Leg Extension Machine. There are various manufacturers of these machines and each one is slightly different. The movement of leg extension exercise begins with choosing the appropriate weight and sit on the machine with legs under the pad (feet pointed forward) and the hands holding the side bars. The legs form a 90-degree angle between the lower and upper leg. The movement involves extension of leg to the maximum when exhale and hold the contracted position for a second. Meanwhile, the rest of the body remains stationary on the seat. Slowly lower the weight back to the normal position as inhale, ensure that do not go past the 90-degree angle limit.

Based on the principle of overload, heavier weights with fewer repetitions and longer rest are best suggested way to improve strength. The most widely used method is lifting a weight that is 70% of 1RM for 10-12 times of repetitions with 1-5 minute breaks in between sets. Strength training for a specific muscle is not advisable to perform for more than once every 48 hours. The duration of this study is 4 weeks because the total time given to conduct this research is too short and one of the purpose of this study is to get an instant result which can help in designing the training program for athletes as well as to improve the quadriceps strength in better way in a short period of time.

### Objectives

To compare the strength of quadriceps muscles between pre and post intervention.

To compare the strength of quadriceps muscles between the experimental group and the control group after 4-week of intervention.

After completion of the 8 sessions of leg extension training, both subjects from experimental group (n = 15) and the control group (n = 15) were asked to perform post-test using the same Leg Extension Machine to measure their 1RM of quadriceps muscles.

## Results

There was a significant differences of the strength of quadriceps muscles between the pre and post-test for the experimental group ( $t = -7.75$ ,  $df = 14$ ,  $p < .05$ ). On the other hand, this study revealed that no significant differences of the strength of quadriceps muscles between the pre and post-test for the control group ( $t = 0.21$ ,  $df = 14$ ,  $p > .05$ ).

Table 1 shows the independent samples  $t$  - test between the Experimental and Control group on the strength of quadriceps muscles (post-test),  $p < .05$ . There was a significant differences of the strength of quadriceps muscles between the experimental and control group during post-test ( $t = 1.97$ ,  $df = 28$ ,  $p < .05$ ).

Table 1: Independent samples  $t$  - test between the Experimental and Control group on the strength of quadriceps muscles (post-test),  $p < .05$ .

Group	Mean Diff.	S.E. Diff	$t$	$df$	Sig. (2-tailed)
Experimental Group & Control Group	2.07	1.05	1.97	28	0.03

## Discussion

The purpose of this study was to determine the effect of 4-week leg extension training on the quadriceps muscles strength. The major finding of this study was that the intervention of the four weeks (8 sessions of resistance training) for the experimental group (n = 15; male = 7; female = 8) induced significant differences ( $t = -7.75$ ,  $df = 14$ ,  $p < .05$ ) on their strength of quadriceps muscles. Studies have proven that the first 6 weeks of resistance training can increase muscle strength at rapid rate even though the rate of increase in muscle fiber cross-sectional area is not that obvious (Knight & Kamen, 2001). The results also supported that muscular strength can be increased by using few sets (Carpinelli, 2002), a moderate number of repetitions (Stone & Coulter, 1994) and a medium low loads. This finding also supports well the statement by some researchers that a frequency of 2 days per week per muscle group training was optimal to increase the muscle strength for trained individuals (Rhe et al., 2003). The result of this study expressed that there was a significant differences of the strength of quadriceps muscles between the experimental and control group during post-test ( $t = 1.97$ ,  $df = 28$ ,  $p < .05$ ). The results supported that resistance training for a particular muscle can improve the muscle strength well within short period of time (less than 6 weeks) if uses the proper training program [6]. In addition, some research has shown that the quadriceps muscles have high potential to increase in strength with resistance training compare to hamstring muscle. Thus, the proper leg extension training can improves as well as help to gain maximal strength of quadriceps muscles. The objectives of this study have been achieved.

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## Methodology

### Subjects

The subjects of this research were chosen from the students of University of Malaya. A total of 30 students (N = 30) were chosen to become the subjects of this research. These subjects were divided into two groups, the experimental group (n = 15) and the control group (n = 15) which respectively with a total of 15 subjects (8 females & 7 males) in the experimental group and 15 subjects (8 females & 7 males) in the control group. The subjects ages between 20 and 21 years (mean age, 20.53 y) were recruited for the study.

### Measurements

In order to assess the strength of quadriceps muscles, the Leg Extension Machine was used as the instrument of this research. The leg extension, typically performed on a leg-extension machine, is a relatively simple exercise. The movement occurs at only one joint and is a basic, limited motion. Leg extension is a measure of the strength of quadriceps muscles because this exercise particularly target a specific muscle; quadriceps. Weight machines are considered a safe, effective and easy-to-learn alternative to free weights (ACSM Stand, 2002). The movement of leg extension exercise begins with choosing the appropriate weight and sit on the machine with legs under the pad (feet pointed forward) and the hands holding the side bars. The legs form a 90-degree angle between the lower and upper leg. The movement involves extension of leg to the maximum when exhale and hold the contracted position for a second. Meanwhile, the rest of the body remains stationary on the seat. Slowly lower the weight back to the normal position as inhale, ensure that do not go past the 90-degree angle limit.

Before undergo the test, the subjects were required to carry out a gentle warm up and light stretching exercises focusing on the lower limbs for at least 5 minutes. According to Prentice (2007) the warm up routine increase body core temperature, stretches ligaments and muscles and increase flexibility. Warm up routine has been found to be important in reducing injury and muscle soreness (Prentice, 2007).

After warm up section, the subject sits on the Leg Extension Machine. The seat was adjusted to the height of subject. Then, the subjects are required to perform with a weight to identify their 1 repetition maximum (1RM). These tests were repeated for both experimental group (G1) and control group (G2). The results were recorded in subject's personal information sheet for data collection. The heaviest weight achieved was considered the pre-training 1RM. The 1RM was determined in fewer than five attempts with a rest interval of 3 minutes between 1RM attempts and 30 min were allowed before the start of the leg extension training for the experimental group. Following the 4 weeks of training, the 1RM was test was performed similarly to the pre-training test in order to compare the strength changes between the G1 and G2.

### Procedure

The 30 subjects were informed and explained that a research entitled "The Effect Of 4-Weeks Leg Extension Training On The Strength Of Quadriceps Muscles" was conducted. They were fully informed of identified procedures prior to enrolment in the study. The subjects were equally divided into two groups using a random sampling with a draw session. All subjects had picked up a number from a box which contained no.1 or 2 where no.1 is experimental group and no.2 is control group.

The following table 1 shows the details of leg extension training session in 4 weeks.

Table 1: 8 Sessions of Leg Extension Training

Weeks	Sessions	Intensity(% of 1RM)	Repetitions	Sets	Rest	Speed
1	1	50	12	3	2	Medium
	2	50	12	3	2	Medium
2	3	50	12	3	2	Medium
	4	50	12	3	2	Medium
3	5	70	12	3	2	Medium
	6	70	12	3	2	Medium
4	7	70	12	3	2	Medium
	8	70	12	3	2	Medium