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Comparison of the increase of both muscle strength and hypertrophy of *biceps brachii* muscle in strengthening exercise with low-intensity resistance training with and without the application of blood flow restriction and high-intensity resistance training

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ABSTRACT

Background: Strengthening exercise is an important component of rehabilitation programs. Recently, it is reported that strengthening exercise with low-intensity resistance training (20-30% of 1 Repetition Maximum) combined with the application of blood flow restriction potentially increases muscle strength and induces muscle hypertrophy as well.

Objective: This study aims to compare the increase in muscle strength and hypertrophy among the muscles trained with high-intensity resistance training (HIRT), low-intensity resistance training combined with the application of blood flow restriction using a sphygmomanometer cuff (LIRT+BFR) and low-intensity resistance training (LIRT) alone.

Method: The subjects ($n=18$) are randomly and equally divided into three groups, those are the groups getting the strengthening exercise for left *Biceps Brachii* muscle with HIRT (70% of 1 RM), LIRT (30% of 1 RM)+BFR and LIRT (30% of 1 RM). Before starting and after getting the resistance training for five weeks, each subject is measured for the left arm circumference.

Results: HIRT and LIRT+BFR produce an increase of the left arm circumference significantly greater than LIRT. However, there is no significant difference in the increase of left arm circumference between the HIRT and LIRT+BFR. There is a significant difference in the increase of the peak torque of left flexion elbow joint among the three groups, either at 60°/s or 120°/s or 180°/s angular velocity. At 60°/s angular velocity, LIRT+BFR produces the greatest increasing of the left elbow peak torque among the three groups. At both 120°/s and 180°/s angular velocity, there is no significant difference in the increase of the peak torque of flexion left elbow joint between HIRT and either LIRT+BFR or LIRT. However, at both 120°/s and 180°/s angular velocity, there is a significant difference in the increase of the peak torque of flexion left elbow joint between LIRT+BFR and LIRT.

Conclusion: the strengthening exercise for *Biceps Brachii* muscle with LIRT+BFR induces the *Biceps Brachii* muscle hypertrophy and increases the muscle strength more than strengthening exercise with LIRT alone. Compared to the HIRT, LIRT+BFR induces an equal muscle hypertrophy and increases more muscle strength for the trained *Biceps Brachii* muscle.

Keywords: Low-intensity resistance training, blood flow restriction, hypertrophy, peak torque

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INTRODUCTION

Strengthening exercise is an important component of rehabilitation programs.^{1,2,3} American College of Sports Medicine (ACSM) recommends that to gain the increase in muscle strength and muscle mass, strengthening exercise with high-intensity resistance training ($\geq 70\%$ of 1 Repetition Maximum) must be performed.⁴

Recently, it is reported that strengthening exercise with low-intensity resistance training (20-30% of 1 Repetition Maximum) combined with the application of blood flow restriction potentially increases muscle strength and induces muscle hypertrophy as well.⁵ It can be very useful of course as an alternative strengthening exercise method for those who are not able to tolerate the high-intensity resistance training.

Almost all of the studies about low-intensity resistance training combined with the application of blood flow restriction used *KAATSU master* pneumatic cuff with 3 cm wide for upper extremities and 5 cm wide for lower extremities.⁷ However, the cuff with that size is difficult to get in Indonesia.

Sphygmomanometer cuff for an adult (13 cm wide) is the kind of cuff that is easy to get in Indonesia. This study aims to compare the increase in muscle strength and hypertrophy among the muscles trained with high-intensity resistance training, low-intensity resistance training combined with the application of blood flow restriction using a sphygmomanometer cuff and low-intensity resistance training alone.

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