

Basic Training of Student's Outdoor Club Increases Muscle Mass after Five Weeks of Exercise in Males

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Abstract

Background: Aerobic and anaerobic exercises, may lead to increase muscle mass. The aim of this study was to determine the change in muscle mass during basic training of students' outdoor club.

Methods: This was an observational analytic study to college students who joined basic training of students' outdoor club for 19 weeks. Subjects consisted of 17 male and 15 female students, measured five times consecutively by using Body Fat/Hydration monitor scale, with Bioelectrical Impedance Analysis principle. Data collection was performed five times, from February to July 2012 in Bandung. Statistical analysis was processed using Analysis of Variance (ANOVA).

Results: The result in males showed the mean 43.35 ± 3.15 on the initial measurement. The muscle mass further increased significantly after five, ten, fifteen, and nineteen weeks of exercise (43.73 ± 3.18 ($p < 0.05$); 44.07 ± 2.97 ($p < 0.05$); 44.08 ± 2.84 ($p < 0.05$); 44.72 ± 2.78 ($p < 0.05$); all data vs 43.35 ± 3.15) respectively. In females, there was increased of muscle mass although not all were statistically significant. The baseline was 37.77 ± 2.00 with increased muscle mass after five, ten, fifteen, and nineteen weeks of exercise (37.78 ± 2.06 ($p > 0.05$); 38.08 ± 1.67 ($p > 0.05$); 38.23 ± 1.52 ($p > 0.05$); 38.61 ± 1.52 ($p < 0.05$) vs 37.77 ± 2.00) respectively.

Conclusion: Basic training of student's outdoor club increases muscle mass significantly after five weeks of exercise in males, but not in females

Key words: Basic training, Bioelectrical Impedance Analysis, hypertrophy, muscle mass, students outdoor club

Introduction

Physical activity is a programmed, structured, and repetitive body movement.¹ Sport is defined as a physical activity which is done to increase health or improve deformity.² Sport is characterized by the differences in intensity, frequency, duration, and type.³ Those characters influence the adaptation of human body to sport, such as muscle hypertrophy.⁴⁻⁶ Hypertrophy is a condition of increasing muscle mass.⁷ Based on the intensity, exercise is classified as mild (less than 50% maximum heart rate), moderate (50–85% maximum heart rate), and heavy (more than 85% maximum heart rate). While maximum heart rate is defined as 220 minus age.⁸

This article reports the result of the study that determined the increase of muscle mass after 19 weeks of exercise.

Methods

The subjects of this study were college students who joined basic training of a students' outdoor club. All of the subjects had been exercising for 19 weeks. They were included in this study after they agreed to participate as a subject in this study. On the other hand, they would be excluded if they had injury or the data needed were not completely collected. Data collection was performed five times, starting from February to July 2012 in Bandung.

After receiving explanation about this study, and filling an informed consent letter, the subjects were included in 19 weeks of exercise. Data collection was performed 5 times during the exercise, in the beginning, fifth week, tenth week, fifteenth week, and nineteenth week of exercise. Data collection was performed

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five times because of differences in intensity exposure that was given in each period. The exposure given in this study started from low to moderate intensity in the first five weeks. In the second period, the intensity was from moderate to heavy. In the third period, tenth to fifteenth week, exercise was performed with moderate intensity. In the fifteenth to nineteenth week, exercise was performed with heavy intensity.

Total sampling method was used to determine the number of samples. A total of 32 subjects were included. Subjects were divided into 2 groups, based on the sex. Muscle mass was defined as muscle proportion of individual's total body weight measured by Body Fat/Hydration monitor scale, designed to measure the composition of fat, water, and muscle of the body by using the Bioelectrical Impedance Analysis.

The outcome of this study was the change of mean muscle mass from the baseline measurement. Used as baseline for this study was the muscle mass determined in the first week, before any exposure was given. Data was processed using the SPSS 17.0 version, and the statistical analysis was carried out using analysis of variance (ANOVA).

Results

Out of 47 subjects who fully participated in the basic training, there were 32 subjects

who met the criteria for this study. Twelve college students were excluded because of incomplete data collection. From those 32 subjects, 17 were male, with mean of age 19.18 (± 1.131), and the remaining were female with mean of age 19.47 (± 0.743).

In male overall, there was a difference in the effect to increase muscle mass with variations of intensity. The exposure given in this study started from low to moderate intensity in the first five weeks. In this period, muscle mass increase was not as big as in the second period, of which intensity was moderate to heavy. In the third period, tenth to fifteenth week, exercise was aimed to maintain the physical condition, by moderate intensity exercise. In the fifteenth to nineteenth week, exercise was with heavy intensity. In this last week, there was high increase in muscle mass compared with the periods before.

The mean of muscle mass in the first measurement which was settled as baseline was 43.35 ± 3.15 percent. There was a substantial increase in muscle mass in every period of measurement, especially in the last week ($p=0.000$ vs baseline) (Figure 1).

The baseline measurement of female subjects was 37.77 ± 2.00 percent, and mean of muscle mass also increased in every measurement, but with statistical significance only in the last week of measurement ($p=0.025$ vs baseline).

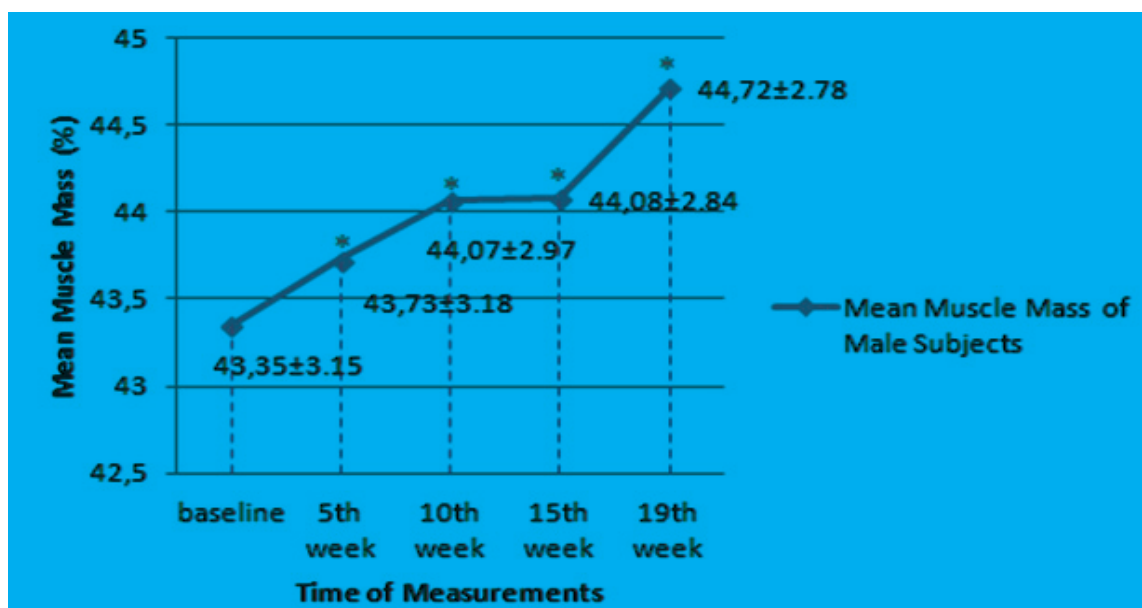


Figure 1 Average Profile of Muscle Mass in Male Subject

Description : * statistically significant compared to baseline

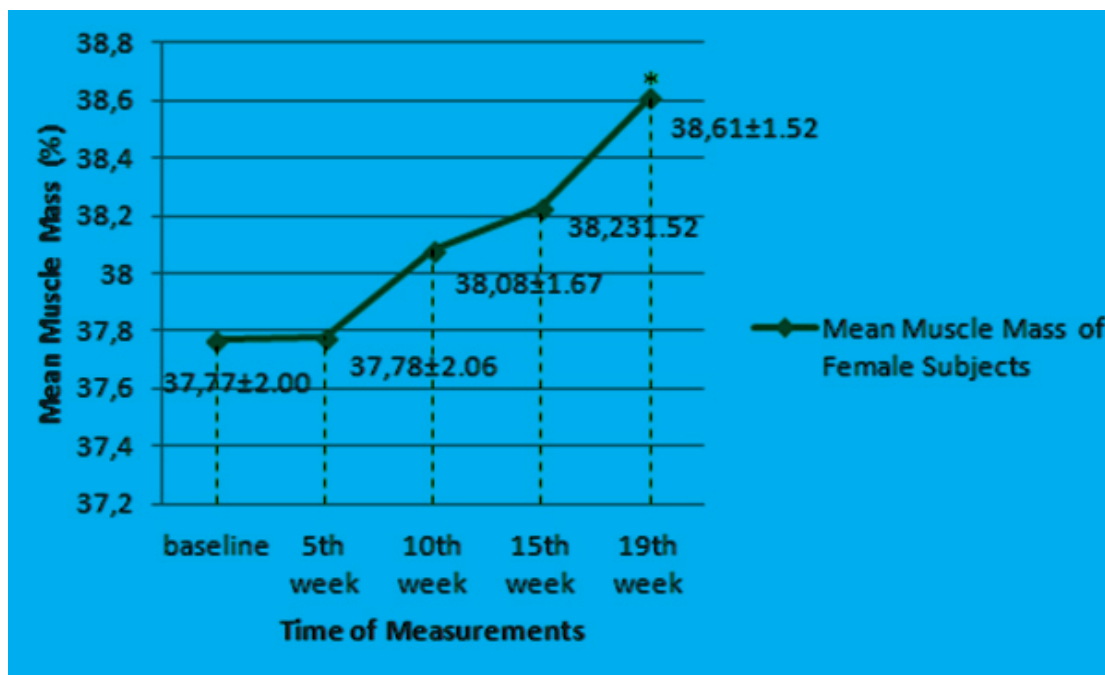


Figure 2 Muscle Mass Profile on Female Subjects

Description : * statistically significant compared to baseline

Discussions

The result of this study showed that there was statistically significant increase in muscle mass of male subjects receiving 19 weeks of training. This result proved that exercise influenced muscle mass. A study that was held by Villareal et al.¹⁰ had similar result. The subjects in that study were adults with obesity, who were given aerobic exercises such as upstairs-downstairs, treadmill, and stationary cycling for 52 weeks with increasing intensity periodically.

One mechanism of increasing muscle mass is hypertrophy, although still in controversy, hyperplasia might also occur. In a person who performs exercise, there is an increasing amino acid transport to muscle cell as a respond to pressure. Amino acid is then rearranged to form contractile protein. Contractile protein increases amount and size of myofibril.⁷

Growth hormone/insulin-like growth factor-1 (GH/IGF-1) and fibroblast growth factor-2 (FGF-2) influence growth. Exercise increases the level of GH/IGF-1 and FGF-2. FGF-2 is responsible for myogenesis and capillary angiogenesis during muscle growth. The IGF-1 maintains muscle mass by suppressing protein degradation, increasing uptake of amino acid, and also stimulating protein synthesis. Protein IGF-1 influences GH in protein synthesis by

increasing amino acid uptake, also reducing the time needed for transcription and translation of mRNA.^{7, 11} Beside that, IGF-1 also has an effect on calcineurin pathway. Calcineurin induces translocation of nuclear factor of activated T-cells (NFAT), the substance that influences growth of skeletal muscle. In muscle with hypertrophy, there is an increasing level of enzymes in mitochondria. This enzyme synthesizes ATP, that has a role in cross bridging of contractile protein when contraction occur.^{12, 13}

The muscle increase in glycogen is stored as respond to exercise.¹⁴ Glycogen is used when there is not enough glucose as energy source.¹⁵ The other local adaptation is the shifting source of energy, from carbohydrate to fat. Using fat as energy source decreases the amount of fat deposit in the body. Muscle and fat are body components, so decreased in fat stored in the body will increase proportion of muscle mass.⁷

In this study, there was no statistically significant result in female, except after the last week of measurement. Basically, female subjects also experiences similar adaptation like in male. The difference between male and female is the hormonal system since male's level of testosterone is more than female's. Testosterone induces transcription, translation, and synthesis of protein in target

cell. Besides that testosterone has an anabolic function that stimulates structural protein synthesis in skeletal muscle and prevents its degradation. This function causes increasing protein deposit, especially in muscle cells.^{7, 16, 17}

On the other side,, estrogen has an effect on fat deposit. Estrogen stimulates the uptake of lipoprotein serum, and causes the decrease in total cholesterol and LDL serum level, increase level of HDL and triglyceride in serum, and decrease lipoprotein A serum. Females have more estrogen level, leads to more fat deposit than males, rather than anabolic effect.⁷

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