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Original Article

Slow-motion in weight training: How does it affect muscle hypertrophy in untrained young men?

DEBY TRI MARIO[1], ANTON KOMAINI[2], WILDA WELIS[3], MUHAMAD SAZELI RIFKI[4], ALNEDRAL[5], NURUL IHSAN[6], DONAL SYAFRIANTO[7], ZULBAHRI[8], ILHAM[9], ARDO OKILANDA[10], ALIMUDDIN[11]
[1.6.8]Department of Sport Education, Faculty of Sport Science, Universitas Negeri Padang, INDONESIA
[2.3.4.7.9.11]Department of Health & Recreation, Faculty of Sport Science, Universitas Negeri Padang, INDONESIA
[5.10]Department of Sport Coaching, Faculty of Sports Science, Universitas Negeri Padang, INDONESIA

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Abstract:
Appropriate training methods and programs in weight training are two important indicators of muscle hypertrophy. However, the movement tempo of each repetition needs to be investigated with certainty to achieve this goal. The purpose of this study was to analyze the effect of slow-motion in weight training on muscle hypertrophy in untrained young men. The design used is a one group pretest-posttest design which is part of the pre-experimental. A total of 13 fitness members of "one gym" in Padang, Indonesia aged 18-25 years were recruited to be the research sample. The procedure in this study consisted of taking pretest data, treatment weight training with slow-motion, and taking posttest data. The treatment focused on the arm and thigh muscles with various variations of movement, and was carried out for ± 2 months. The instrument used is a tape measure and skinfold thickness, then the data is analyzed by paired samples t-test. The results showed that there was an effect of weight training with slow-motion on muscle hypertrophy (Sig. 2-tailed < 0.05), with a difference of 6.87 for the arm muscle and 10.46 for the thigh muscle (pretest-posttest data). The relationship was significant and linear, with r values for arm muscle 0.965, and thigh muscle 0.889. In conclusion, slow-motion in weight training can produce muscle hypertrophy in untrained young men. This study is expected to be useful for weight training practitioners in choosing training methods to obtain muscle hypertrophy (especially for beginners), fitness instructors, and athletes. Future study is needed to involve comparison groups (other types of weight training methods) and a wider sample size. Then, weight training carried out by any method, without being supported by adequate nutrition (protein), it is impossible to produce optimal muscle hypertrophy. This is also a good opportunity for future study involving proteins and comparing them with different types of training methods.
Keywords: hypertrophy; slow motion; weight training; untrained young man.

Introduction

Muscular hypertrophy is a required component in most sports (Herman et al., 2010; Jones et al., 2008), and one of the goals of bodybuilding (Hackett et al., 2013). Muscle hypertrophy can happen when muscle protein synthesis outpaces its breakdown and results in equilibrium over time (Damas et al., 2017). Resistance training and adequate protein intake can help in this achievement (Mario et al., 2022; Phillips, 2014). Low muscle mass is often associated with an increased risk of various diseases, such as cardiovascular disease (Srikanthan et al., 2016), cardio-metabolic in adolescents (Burrows et al., 2017), and type II diabetes in those who are at least middle-aged (Son et al., 2017). Therefore, adequate muscle mass is often associated with health that is useful for productive survival.

With regard to resistance training, several previous studies have discussed extensively to maximize muscle adaptation, such as exercise volume, exercise intensity, exercise repetitions, sets, movement speed, and pauses in between sets for rest (Kraemer et al., 2002; Ralston et al., 2018). Additionally, essential elements that directly influence muscle adaptation are training volume and intensity (Schoenfeld et al., 2017; Schoenfeld et al., 2015). The American College of Sports Medicine recommends, for beginners is thirteen sets per exercise, eight to twelve repetitions with seventy to eighty five percent of one repetition maximum. Whereas for advanced individuals it is three to six sets, one to twelve repetitions with seventy to one hundred percent of one repetition maximum (Kraemer et al., 2002). In this regard, movement tempo is an often overlooked indicator of muscle hypertrophy (Pereira & Gomes, 2003; Schoenfeld et al., 2017). Lacerda et al., reported that important elements including time under stress, metabolic reactions, hormones, and muscle activation that are essential in the growth of muscle hypertrophy and strength can be affected by the speed of movement (Lacerda et al., 2016).

Corresponding Author: ANTON KOMAINI, E-mail: antonkomaini@fik.unp.ac.id

Movement tempo is the duration of each repetition according to the duration of a certain movement phase (English et al., 2014). The number of repetitions in a set, the maximum time under strain, and the exercise volume will all change depending on changes in movement tempo during resistance training (Sakamoto & Sinclair, 2006; Wilk et al., 2018). According to numerous study, a faster movement tempo will lead to a noticeably higher number of repetitions compared to a slower movement tempo (Hatfield et al., 2006; Sakamoto & Sinclair, 2006; Wilk et al., 2018). In contrast, sluggish movement speed will result in fewer repetitions but more time spent under tension, which will cause muscular growth (Burd et al., 2012). Another study reported that hypertrophy occurred when the repetition duration ranged from 0.5 to 8 seconds (Schoenfeld et al., 2015). However, it should be remembered that they have no control on how long a specific movement phase lasts (Schoenfeld et al., 2015), so it is difficult to draw a definite conclusion.

The movement tempo of resistance training is very important to discuss, because it can significantly affect adaptation to training. Even though study on resistance training is widespread, few studies have examined how movement speed affects the muscle hypertrophy adaptation process (Golas et al., 2018; Headley et al., 2011; Maszczyk et al., 2016; Sakamoto & Sinclair, 2006; Wilk et al., 2018). Several studies have also examined the tempo of movement in resistance training such as whether the slow-motion method can be applied to resistance training using body weight in the elderly (Tsuzuku et al., 2018; Watanabe et al., 2015).

This study was conducted on the elderly, but has not been performed on untrained young men. Studies comparing the effects of isotonic resistance training on adult athletes' strength and muscle hypertrophy in rapid and slow-motion (Pereira et al., 2016). These studies were conducted on trained adults, but have not been performed on untrained young men. Strength gains made by adult women who participated in three different training regimens, conventional strength training, traditional resistance training, and low speed training, were correlated with increases in muscle fiber cross-sectional area (Herman et al., 2010). These studies were conducted on adult women, but have not been performed on untrained young men. Thus, there are very few studies examining the effect of slow-motion in weight training on muscle hypertrophy in untrained young men.

The purpose of this study was to analyze the effect of slow-motion in weight training on muscle hypertrophy in untrained young men. This study is anticipated to be helpful for athletes, fitness instructors, and weight training practitioners in selecting training strategies to generate muscular hypertrophy (especially for beginners).

Methods

Study design

The design used is a one group pretest-posttest design which is part of the pre-experimental, which consists of pretest, treatment, and posttest. Because the pretest and posttest data are compared after the treatment is administered, this design seeks to make it possible to clearly understand the treatment's final results.

Participant

A total of 13 fitness members of "one gym" in Padang, Indonesia were used as research samples, which were recruited randomly. Several considerations are also needed in the recruitment of samples, including: (1) the sample is male aged 18-25 years, (2) the sample is registered ± 1 month at the fitness center, (3) the sample wants or is undergoing a hypertrophy program, (4) the sample has never taken a high protein supplement, (5) the sample is willing to voluntarily and comply with all provisions during the treatment.

Procedure

The procedure in this study is similar to that used by Mario et al., the difference is that this study did not use protein in the treatment (Mario et al., 2022). The procedures include: (1) Stage 1, before receiving treatment, the sample's muscle size was determined by measuring the diameter of its arm and thigh muscles (pretest); (2) Stage 2, treatment the arm and thigh muscles to slow-motion weight training.

Barbell curls, bent-over tricep extensions, dumbbell hammer curls, overhead dumbbell extensions, and tricep pressdown are all weight training exercises for the arms. Leg press, squat, leg extension, and leg curl are exercises for the thighs. Weight training is administered for approximately two months at a frequency of four times per week, at an intensity of seventy-five to eighty-five percent, for four to twelve repetitions, one to five sets, and at intervals of thirty to forty seconds (Mario et al., 2022). Then, Stage 3, to determine the impact of the treatment, the measurement was again carried out on the circumference of the arm and thigh muscles (posttest).

Instruments

Measuring tape and skinfold thickness are the instruments used in this study (Mario et al., 2022). Tape measure to measure muscle circumference and skinfold to measure muscle fat thickness. Then, the data is formulated using the formula "MMC = MMC-(3.14 x SFT)" (Caballero et al., 2005).

Statistic analysis

Descryiptive statistics and t-test were used to analyze the data. The distribution of data on the pretest and posttest was determined using descriptive statistical analysis. Meanwhile, paired sample t-test analysis was used to determine whether there was a difference between the pretest and posttest data.

Result

The results of descriptive statistics showed that the mean of the pretest for hypertrophy of the arm muscles was 255.61 and the posttest was 262.48. Then, the mean of the pretest for hypertrophy of the thigh muscles was 458.32 and the posttest was 468.78.

Table 1. Description of data

Muscle	Data	N	Min	Max	Mean	Std. dev	Average difference
Arm	Pre-test	13	230.30	290.02	255.61	17.69	6.87
	Post-test	13	231.30	299.16	262.48	17.21	
Thigh	Pre-test	13	441.74	479.76	458.32	8.72	10.46
	Post-test	13	449.02	492.90	468.78	11.54	

The mean posttest data in Table 1 is higher than the pretest data. That is, there is an increase in the average muscle hypertrophy after being given weight training treatment with slow-motion (Figure 1).

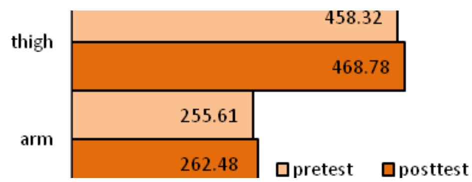

Figure 1. The mean difference for both data (pretest-posttest)

The results of the normality test showed that the pretest-posttest data were normally distributed (Sig. > 0.05) (Table 2). Figure 2 also shows that the data approach or follow the diagonal line. Then, the results of the homogeneity test in Table 2 also show that the pretest and posttest data are homogeneous (Sig. > 0.05).

Table 2. Test for normality and homogeneity of data

Muscle	Data	df	Shapiro-wilk		Levene's		
			Statistic	Sig.	df	F	Sig.
Arm	Pre-test	13	.973	.924	24	.135	.716
	Post-test	13	.964	.811			
Thigh	Pre-test	13	.892	.104	24	.991	.329
	Post-test	13	.947	.547			

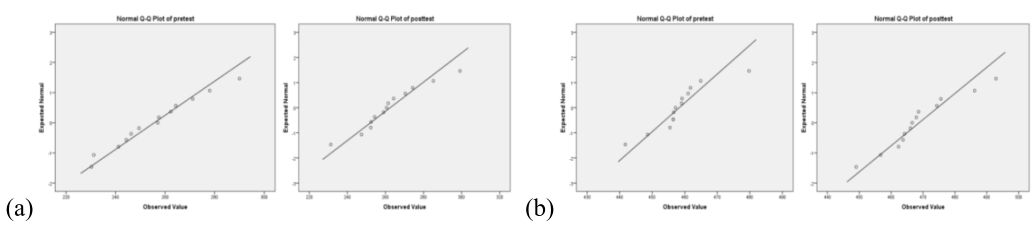

Figure 2. (a) Arm muscle pretest and posttest, (b) Thigh muscle pretest and posttest

Then, the results of hypothesis testing indicate that there is an effect of weight training with slow-motion on muscle hypertrophy. The considerable difference between the pretest and posttest results serves as proof of this (Sig. 2-tailed < 0.05) (Table 3).

Table 3. Paired samples t-test

Muscle	Data	R	Sig.	Paired differences					t	Sig. (2-tailed)
				Mean	Std. dev	Std. error mean	95% confidence			
							Lower	Upper		
Arm	Pretest-posttest	.965	.000	6.87	4.64	1.29	9.67	4.07	5.34	.000
Thigh	Pretest-posttest	.889	.000	10.46	5.51	1.53	13.79	7.13	6.85	.000

The average results of posttest data increased after being given weight training treatment with slow-motion. Pretest-posttest data for arm muscle hypertrophy 255.61 < 262.48, and pretest-posttest for thigh muscle hypertrophy 458.32 < 468.78. The difference for the arm muscle is 6.87, and the thigh muscle is 10.46. Then, the value of "r" in Table 3 also shows that there is a significant correlation between the pretest and posttest data for muscle hypertrophy (Sig. < 0.05), and each has a linear relationship (Y = 1.749 + 0.965X and Y = 5.552 + 0.889X) (Figure 3).

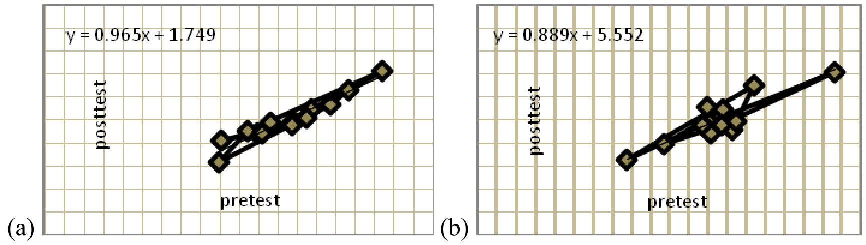

Figure 3. (a) Pretest-posttest of arm muscle, (b) Pretest-posttest of thigh muscle

Discussion

Based on these findings, that weight training with slow-motion has an impact on muscle hypertrophy in untrained young men (Sig. 2-tailed < 0.05). This is also evidenced from the pretest-posttest data for arm muscle hypertrophy 255.61 < 262.48, and thigh muscle hypertrophy 458.32 < 468.78. Thus, to achieve muscle hypertrophy, slow-motion in weight training can be used as a training approach (especially for beginners). The results of this study support past studies that found a connection between slow-motion resistance training and increased muscle hypertrophy (Tanimoto et al., 2008; Tsuzuku et al., 2007; Watanabe et al., 2013). Additionally, they noted that slow lifting resulted in a faster rate of myofibrillar protein production than did lifting at a regular speed (1 second up and 1 second down) (Burd et al., 2010).

These results suggest that a long total contraction time (slow-motion) is important for muscle hypertrophy (Holm et al., 2008). Additionally, earlier studies shown that muscle hypertrophy is frequently stimulated by slower motions (Gumucio et al., 2015), and swifter motions are frequently employed for muscle strength (Bird et al., 2005). Therefore, it is advantageous for muscle hypertrophy to extend the eccentric movement phase (Gumucio et al., 2015; Roig et al., 2008; Schoenfeld et al., 2017). Numerous studies show that slower speeds during the eccentric phase cause more strain in the muscles (Golas et al., 2018), and affects the hypertrophy of muscles (Bird et al., 2005; Burd et al., 2010; Gehlert et al., 2015), although protein synthesis promotes the lengthening of the duration of muscular tension (Burd et al., 2010).

Resistance training with slow-motion is more effective for increasing muscle hypertrophy and strength (Pereira et al., 2016). The extended period of time under muscle tension, particularly with the slower eccentric phase, can be used to explain the higher hypertrophy in slow-motion (Schoenfeld et al., 2015). This results in higher muscle tension, with stress levels on a smaller number of active fibers, resulting in greater muscle damage (Schoenfeld et al., 2015). The optimal approach for increasing training response resistance is periodization with variations in the training variables, which allows continuous adaptation of training (Headley et al., 2011; Kraemer et al., 2002). This type of training is important for the hypertrophy mechanism that leads to muscle activation and increased lactate (Lacerda et al., 2016). Higher lactate concentrations cause protein synthesis to increase through increased cell swelling and mediate anabolic hormones and cytokines increases (Schoenfeld et al., 2015). Then, various repetitions can be used to develop hypertrophy and muscle strength (Kraemer et al., 2002). Thus, carefully planned training that is founded on principles of practice will produce the intended effects (Mario et al., 2022; Pagliara et al., 2020; Santos et al., 2020), and adequate protein intake (muscle requirements) are important to obtain optimal muscle hypertrophy (Mario et al., 2022). Additionally, it is important to acknowledge the contribution of science and technology to this success (Firdaus & Mario, 2022; Komaini et al., 2021; Rifki et al., 2022). According to the data we gathered, slow-motion in weight training has the potential to muscle hypertrophy. However, we are aware that this study has certain limitations. The weight training given is using the slow-motion method, so it is necessary to involve other types of weight training methods to compare the effectiveness of this treatment. The sample used is young men who are not trained, so it is necessary to involve different genders and ages. A larger sample size must be employed because the current sample size is still insufficient. We do this to help regulate and reduce treatment-related mistakes.

Conclusions

Slow-motion in weight training can produce muscle hypertrophy in untrained young men. This is evidenced from the pretest-posttest data for arm muscle hypertrophy 255.61 < 262.48, and thigh muscle hypertrophy 458.32 < 468.78. The difference in the mean between the pretest-posttest data was 6.87 for the arm muscle, and 10.46 for the thigh muscle. The value of r also indicates that there is a significant and linear correlation between the pretest and posttest data. Thus, slow-motion tempo in weight training can stimulate muscle hypertrophy in untrained young men. This study is expected to be useful for weight training practitioners in choosing training methods to obtain muscle hypertrophy, both for fitness instructors and athletes. Weight training performed by any method, without being supported by adequate nutrition (protein), is impossible to produce optimal muscle hypertrophy. Therefore, recommendations for future study are very important to involve protein intake in weight training. Then, the comparison group (another type of weight training method), the size and diversity of the sample.

Conflict of interest- no potential conflicts of interest

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