

The effect of weight training with compound set method on strength and endurance among archery athletes

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Abstract

The compound set method aims to drill similar parts of muscles using different tools. The study's purpose was to determine how much impact weight training with compound set methods can give to the strength and endurance of archery athletes. The methodology of this research is using the methodology of experiment with one group of pre-test and post-test designs. The form of treatment in the experimental group by doing weight training with the compound set method with a dose of exercise carried out for 8 weeks with an intensity of 60-80% of 1 RM, 3-4 sets, 15-25 repetitions, and 1-2 minutes of rest between sets. The study population was Yogyakarta State University archery athletes selected via purposive sampling. The instrument used to measure muscle strength is the hand grip strength test. Meanwhile, to measure the upper, lower, and middle body for the endurance of muscular test, four kinds of test items were used namely bench jump, bent leg curl-ups, abdominal crunches, modified dips (man), and modified push-ups (woman). The data analysis technique used a normality test to determine whether the data were normally distributed, a homogeneity test of variation to measure the similarity of variance in the experimental group, and hypothesis testing using a t-test. The results of the t-test obtained a t-count value of 14,532 with a significance value of 0.000 ($p < 0.05$), indicating that weight training with the compound set method has a significant effect on increasing the arm muscle strength of archery athletes. As for muscle endurance, the results of the t-test analysis obtained a t-count value of 13,396 with a significance value of 0.000 ($p < 0.05$). This shows that weight training with the compound set method has a significant effect on increasing the endurance of archery athletes. Therefore, the usage of the compound set method can give maximum progress to a trained group of muscles, so the possibility to increase muscular endurance is potentially good.

Keywords: Weight training, compound set, strength, endurance, archery

Introduction

Archery is a sport that uses a bow to shoot arrows at a target or target (Dhawale, 2018). Archery is a sport that requires consistent and stable movements (Park et al., 2016). The current development, archery is in great demand by the community and is carried out by all groups, both children, adolescents, and adults. Archery is not only used as a recreational sport but also as an achievement sport. In line with the growth and development of archery, professional archery athletes are needed. Archery is a social sport that can relax the body and can be used as a sport to achieve achievement, so that basic techniques, movement mechanisms, and physical and mental conditions become a unit that must be owned by beginner or professional archers (Bramantha & Setiawan, 2022). Untrained physical, mental, and physiological factors can affect the appearance and accuracy of archery athletes (Spratford & Campbell, 2017). Physical ability will contribute to the athlete's achievement, structured, regular, and programmed physical training is considered important (Kristiyanto et al., 2020). Therefore, to achieve the highest achievement, archery athletes need to prepare their physical, technical, tactical, and mental abilities.

One of the physical components that are rarely considered but have an important role for archery athletes is muscle strength and endurance (Simsek et al., 2018). Physical components in the form of muscle strength and endurance make a significant contribution to archery athletes in supporting achievement, especially in the arm muscles. Arm muscle strength training in archery is one of the important factors in archery to shoot according to the right targets to get a high score (Sezer, 2017). Muscle strength and endurance are the ability of muscle groups to perform contractions maximally and repeatedly for a certain duration, long enough to cause muscle fatigue, and/or the ability of muscles to maintain contractions to the maximum for long periods (Schoenfeld et al., 2021). They are needed to maintain activities that are dominated by the use of muscles or muscle groups. Muscle strength and endurance will gradually decrease with age, therefore a training method is

needed to train muscle endurance (Russo et al., 2021). One training method to train the strength of muscles endurance is weight training (Nasrulloh et al., 2020).

Weight training is a systematic exercise using weights as a tool to train physical condition, increase muscle strength, and prevent injury (El-Kotob et al., 2020). Weight training may utilize the weight from one's own body such as chin-ups, jumping jacks, push-ups, planks, sit-ups, lunges, squats, or back-ups (Vorbeck & Bördlein, 2020). Additionally, weight training may be performed using external, free weights such as dumbbells, barbells, and gym machines. In doing weight training, an appropriate training method is necessary so that the objectives of the training can be properly achieved (Stricker et al., 2020). The most common weight training methods include compound sets, supersets, set blocks, giant sets, system sets, tri-sets, pro sets, pyramids, and circuit weight training (Nugroho et al., 2021). In choosing the training method, it is important to pay attention to the goals and objectives of the training, so that mistakes do not occur during the training process (Sutapa et al., 2020).

Weight training will be more beneficial for increasing muscle strength and endurance (Mills et al., 2020). Many studies have proven the positive effect of weight training on muscle strength and endurance. Weight training increases muscle strength, muscle endurance, neuromuscular coordination, and bone density (which helps prevent osteoporosis) (Boullousa et al., 2020). Performance determinants are markedly improved by weight training; it increases athlete strength and power, but does not increase total body mass and sacrifices maximal oxygen consumption (VO₂max) (Psilander et al., 2019). Strength training programs are very important to increase muscle strength in adults. Outside of periods of strength training, strength can be significantly increased in knee flexion and extension strengths (Gargallo et al., 2018).

From some of the literature reviews above, it can be said that archery athletes need muscle strength and endurance to support their performance when competing to achieve the best performance. Therefore, proper physical exercise is needed to increase the strength and endurance of archery athletes. Weight training is one of the appropriate alternatives to physical exercise to improve both. One of the widely recognized physical training methods that can contribute to the success of athletes is muscle strength and endurance through the compound set method in weight training (Saric et al., 2019). A compound set is an exercise using two different types of equipment to train a similar group of muscles consecutively, with no rest when switching tools (Merrigan et al., 2019; Nasrulloh et al., 2018). This study was conducted to know how much influence weight training with the compound set method has on the strength and endurance of archery athletes, especially arm muscle strength, and upper, middle, and lower body muscle endurance.

Materials and methods

The population under study is the archery athletes at Yogyakarta State University archery athletes selected by purposive sampling with the criteria of active students aged between 17-22 years old, active exercise for at least 2 months, and willing to be a sample in research. Sampling was carried out twice for the control group (samples without the compound set training as a pre-test) and the treatment group (samples being treated with the compound set weight training as post-test).

The instrument used in this study was to use a hand grip strength test to measure arm muscle strength. Meanwhile, to measure upper, lower, and middle body muscle endurance using the muscular endurance test with four kinds of test items, namely bench jump, bent leg curl-ups, abdominal crunches, modified dips (man), and modified push-ups (woman) (Hoeger et al., 2019). The data analysis technique used a normality test to determine whether the data were normally distributed, a homogeneity test of variation to measure the similarity of variance in the experimental group, and hypothesis testing using a t-test. This study hypothesizes that weight training with the compound set method has a significant effect on increasing the strength and endurance of archery athletes (H1).

There are several training methods to train the strength and endurance of muscles. To be meaningful, exercises that are carried out must adhere to an appropriate training program and apply the appropriate method. This program is carried out by combining the principles of weight training with the appropriate training components and the right training dose. It must also adopt the right training method. One of the training methods which may potentially train strength and endurance muscles is the compound set method. Weight training with the compound set method is expected to contribute to increasing muscle strength and endurance. The exercise program in the form of treatment given to the experimental group was by doing weight training with the compound set method with a dose of exercise carried out for 8 weeks with an intensity of 60-80% 1RM, 3-4 sets, 15-25 repetitions, and 1-2 minutes of rest between sets.

Results

This research data is the result of measuring the effect of weight training with the compound set method on the strength and endurance of archery athletes' muscle mass. Measurement of data was carried out twice before the test (pre-test) and after the test (post-test). Data analysis was done descriptively. The results of the descriptive analysis of the strength data can be presented in the following table.

Table 1. Descriptive analysis of strength data

Observation	Pre-test	Post-test
Min.	47.00	72.16
Max.	112.86	142.12
Mean	82.72	111.67
Median	87.34	128.48
Mode	105.82	72.16
Std. Dev.	23.07	27.79

The results of the strength data analysis at the time of the pre-test the lowest score was 47.00 and the highest score was 112.86. While the results of the strength data analysis at the time of the post-test were obtained the lowest score was 72.16 and the highest score was 142.12. The mean value of the strength at the pre-test was 82.72, and the post-test was 111.67 so the increase in strength was obtained by 28.95. The increase in strength after weight training with the compound set method is illustrated in Figure 1.

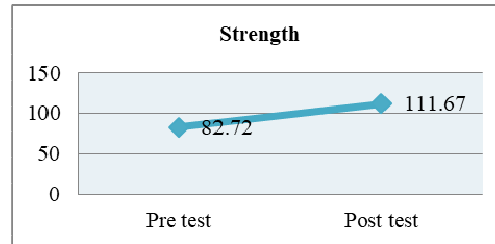


Figure 1. The average pre-test and post-test for strength

Furthermore, a descriptive analysis of muscle endurance data is shown in the table 2.

Table 2. Descriptive analysis of muscle endurance data

Observation	Pre-test	Post-test
Min.	5.00	8.00
Max.	10.00	14.00
Mean	7.06	11.26
Median	6.00	11.00
Mode	6.00	10.00
Std. Dev.	1.86	1.90

The results of the analysis of muscle endurance data at the time of the pre-test the lowest score was 5.00 and the highest score was 8.00. While the results of the analysis of muscle endurance data at the time of the post-test obtained the lowest score was 8.00 and the highest score was 14.00. The mean value of muscle endurance during the pre-test was 7.06, at the post-test it was 11.26, increasing muscle endurance to 4.2. Increased muscular endurance after weight training with the compound set method is reflected in Figure 2.

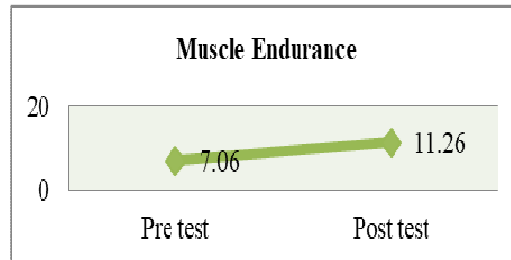


Figure 2. The average pre-test and post-test for muscle endurance

The research variable data is subsequently classified based on the norms of muscular strength and endurance assessment in 5 categories, which are Excellent, Good, Average, Fair, and Poor. The results of the strength classification are shown in the following table.

Table 3. Classification of Strength Data

Category	Pre-test		Post-test	
	Frequency	%	Frequency	%
Excellent	0	0.0	2	13.3
Good	1	6.7	8	53.3
Average	0	0.0	3	20.0
Fair	3	20.0	2	13.3
Poor	11	73.3	0	0.0
Total	15	100.0	15	100.0

The majority of pre-test strength data in the poor category was 11 people (73.3%). The majority of post-test in the good category of 8 people (53.3%), indicate an increase in strength after weight training using the compound set method. The results of the classification of strength data are shown in Figure 3.

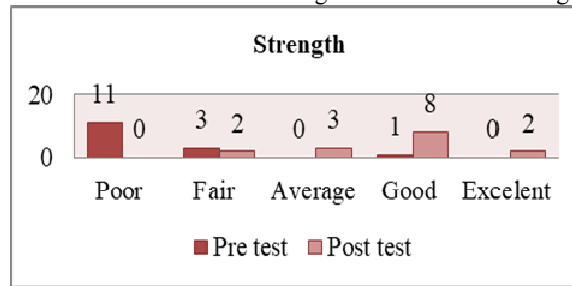


Figure 3. Classification of Strength Data

The results for muscle endurance classification are shown in Table 4.

Table 4. Classification of Muscle Endurance Data

Category	Pre-test		Post-test	
	Frequency	%	Frequency	%
Excellent	0	0.0	5	33.3
Good	3	20.0	7	46.7
Average	4	26.7	3	20.0
Fair	8	53.3	0	0.0
Poor	0	0.0	0	0.0
Total	15	100.0	15	100.0

The majority of muscle endurance data during the pre-test was in the fair category of 8 people (53.3%). When the majority of post-test were in the good category of 7 people (46.7%), this showed an increase in muscle endurance after weight training with the compound set method as can be seen in Figure 4.

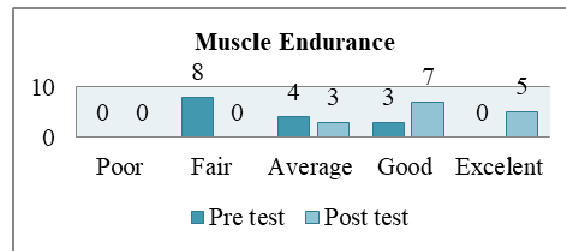


Figure 4. Classification of Muscle Endurance Data

The research data were tested for normality and homogeneity, followed by a t-test to test the hypothesis. The results of the calculation of the normality of muscle strength and muscle endurance data obtained a significance value of $p > 0.05$ in all groups which indicates that the data on muscle strength and muscle endurance are normally distributed. The results of the homogeneity test of muscle strength measurement data obtained a calculated F value of 2.134 with a significance value of 0.155 ($p > 0.05$), while muscle endurance obtained a calculated F value of 0.033 with a significance value of 0.856 ($p > 0.05$). It can be concluded that the data on muscle strength and muscle endurance measured are homogeneous. After obtaining these results, then proceed with the t-test as shown in table 5.

Table 5. T-test results for muscle strength and endurance data

Data	Test	Mean	T-value	p	Info
Muscle strength	Pre-test	82.72	14.532	0.000	Sig.
	Post-test	111.67			
Muscle Endurance	Pre-test	7.06	12.860	0.000	Sig.
	Post-test	11.26			

The data then underwent the parametric t-test. The t-test for strength data obtained the value of t at -14.532 with a significance value of 0.000 ($p < 0.05$), which means that there are significant differences in muscle strength during pre-test and post-test. The interpretation of the results is that weight training using the compound set method on increasing the strength of archery athletes has a significant effect. The results of the t-test analysis of muscle endurance data obtained the t value of 13.396 with a significance value of 0.000 ($p < 0.05$), which means there is a significant difference in muscle endurance during pre-test and post-test. The interpretation of the

results is that there is a significant effect of weight training with the compound set method on increasing the muscle endurance of archery athletes.

Discussion

Archery is a sport that requires certain physical abilities. To support the performance of archery athletes, good physical abilities are needed. Good physical abilities are obtained with structured, organized, and programmed physical exercises. One of the physical training programs that are needed and are considered capable of making a significant contribution to the success of athletes is weight training. Weight training can increase muscle strength and endurance.

Muscle strength was the ability of a group of muscles to exert maximum force against resistance (Fragala et al., 2019). Muscle strength is the maximum force that a particular muscle or muscle group can produce (García-Hermoso et al., 2020). Mechanically, muscle strength was defined as a force produced by a group of muscles in maximally contracting the load being lifted. Muscular strength was the ability of a muscle or group of muscles to contract, either pulling or pushing maximally against resistance in the form of a lifted load (Nasrulloh et al., 2021). Muscle endurance was the ability of muscle groups to perform repetitive contractions over some time long enough to cause muscle fatigue or to maintain a certain percentage of maximum contractions for long periods (Blasquez Shigaki et al., 2020). Muscular endurance was the ability of a group of muscles to repeatedly exert submaximal force over a long time (Haible et al., 2020). Based on these definitions, it can be stated that muscle endurance was the ability of muscle groups to contract repeatedly over a certain long time enough to cause muscle fatigue, and/or the ability of muscles to sustain contractions to the maximum for long periods. Therefore, weight training is needed to improve physical abilities in the form of muscle strength and endurance in a measured, regular and programmed manner.

Weight training is training with weights to increase a person's ability to exert maximum energy, to increase strength, endurance, and muscle hypertrophy (Ahmeti et al., 2020) Weight training can increase muscle hypertrophy and increase muscle strength, one of the most appropriate ways is to do exercises to the point of willpower failure (Lopez et al., 2021). Weight training is an exercise that is carried out programmatically using a tool in the form of an appropriate loading mode, which aims to increase muscle strength (Bompa & Buzzichelli, 2015; Prasetyo & Nasrulloh, 2017). Weight training is a form of an exercise program that is structured in detail as an effort to increase muscle strength and endurance by providing a continuously increasing load (Mohamed et al., 2019).

The compound set method is one of the weight training methods. Weight training performed with compound sets has been shown to induce gains in increasing muscle strength, and endurance (Merrigan et al., 2019). This method is where a person does two exercises to train the same muscle group in sequence, without a break in between (Kramer, 2020). The recommended weight training with the compound set method with a dose of exercise carried out for 8 weeks with an intensity of 60-80% 1RM, a number of sets: 3-4 sets, repetitions: 15-25 repetitions, and rest between sets of 1-2 minutes. Which is proven to be effective increase muscle strength and endurance, as shown in Table 3. The results from the pre-test time (with the majority) in the bad category were 11 people (73.3%) to the majority in the good category as many as 8 people (53.3%) at the post-test showed a significant increase in strength after weight training using the compound set method. This is also shown in the t-test results in Table 5 with a value of 0.000 ($p < 0.05$) which indicates that there is a significant difference in strength. The interpretation of these results is that weight training with the compound set method has a significant effect on increasing the strength of archery athletes.

Compound set weight training also increases muscle endurance as shown in Table 5, where there is an increase in muscle endurance from the pre-test majority in the moderate category as many as 8 people (53.3%) to the majority in the good category as many as 7 people (46.7 people). %) during the post-test. This shows that there is an increase in muscle endurance after weight training using the compound set method. This is also reflected in Table 5 with a value of 0.000 ($p < 0.000$) which indicates that there is a significant difference in muscle endurance. The interpretation of these results is that weight training with the compound set method has a significant effect on increasing the muscular endurance of archery athletes. As such, weight training using the compound set method can significantly increase the strength and endurance of archery athletes.

Conclusions

The conclusion is that there is a significant effect of weight training performed with the compound set method in significantly increasing arm muscle strength and upper, middle, and lower body muscle endurance. We recommend that weight training with the compound set method with a dose of exercise carried out for 8 weeks with an intensity of 60-80% of 1 RM, 3-4 sets, 15-25 repetitions, and 1-2 minutes of rest between sets, proven to significantly increase muscle strength and endurance in archery athletes. So we can say that our findings are that weight training performed with the compound set method can be used as an alternative form of weight training that can be trained on archery athletes to increase muscle strength and endurance. With increasing, muscle strength and endurance in archery athletes can be used as a support in improving performance when competing to get the highest achievement.

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