

The Effect of 6-Week Different Resistance Training on Shooting Performance among Elite Archers

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ABSTRACT

Archery is a sport that needs archers to shoot the arrows to the target by using a bow that requires muscular strength and endurance to form a proper technique to hit the target precisely. Therefore, the purpose of this study is to investigate the effects of 6-week different resistance training on shooting accuracy among archers. This study was carried out using an experimental research design. 12 men were recruited in this study and were divided into two groups; muscular strength training group (n = 6) and muscular endurance training group (n = 6). Both groups had undergone 6-week training program differently and had to perform pre- and post-shooting tests. The result showed that there was a significant increment in the shooting accuracy in muscular strength group (p = .000) and muscular endurance group (p = .001). This increment was reflected in the nature of the archers when they had to pull the string strongly and repeatedly during a game. In conclusion, the 6-week resistance training has had a positive influence towards archers' shooting accuracy. Future studies are recommended to compare between elite and non-elite archers for new finding on accuracy.

Keywords: archery, muscular endurance training, muscular strength training, shooting accuracy

INTRODUCTION

Archery is a sport enjoyed by millions of people of all ages and abilities worldwide, including people with physical mobility limitations in adaptive recreational or school physical education programs (Deviterne, Gauchard, Lavisse & Perrin, 2007). Archery had its debut in the 1900 Summer Olympics and has been contested in 16 Olympiads (Archery - News, Athletes, Highlights & More, 2023). Various

skills are necessary to achieve good performance in archery while the improvement of performance are related to many factors including skills and fitness (Kim, Kim & So, 2014). Competitive archers make a large number of shots, and they are required to repeat the same action consistently (Leroyer, Van Hoecke & Helal, 1993; Martin, Siler & Hoffman, 1990) as they need to compete for points by shooting a number of arrows within a given time (Takai, Kubo & Araki, 2012). It is seen as a sport that involves driving arrows with a bow to the target in the course of shooting (Ahmad et al., 2014) which involves contraction and relaxation strategy of forearm muscles during the release of the bowstring. It primarily consists of three phases that are the stance phase, the arming phase (archer pulls the bowstring and pushes the bow) and the sighting phase (the final stretching of the bow while focusing on the target (Leroyer, Van Hoecke & Helal, 1993). Alternatively, Nishizono, Shibayama, Izuta and Saito (1987) suggested previously that a shot can be divided into six stages which are bow hold, drawing, full draw, aiming, release, and follow-through.

The goal in archery is to shoot to the butt (target board in archery) as points will be earned based on the color and circle associated with the hit target. To win the match, the archer has to score higher points compared to the opponent by using one bow, one target, sufficient number of arrows and various other small supporting equipment (Sezer, 2017). Taking a large number of shots in one competition into account, the shooting movement of an archer is required to be highly reproducible. Therefore, the possession of certain physical fitness variables, such as upper body muscular strength, as well as muscular endurance, might be the factors that could determine the outcomes of their performance in the sport of archery (Kolayış & Ertan, 2016; Ertan, Kentel, Tumer & Korkusuz, 2003; Martin, Siler & Hoffman, 1990). Muscular strength is the ability of the muscle to produce maximal force (Taber et al., 2016). Adjusting the muscle strength especially the upper body, which is drawing the arm, is the job of the shoulder during the pushing motion of the bow. To draw a bow, you need a strong enough shoulder muscle (Simsek, Cerrah, Ertan & Soylu, 2018; Kolayış & Ertan, 2016). High levels of arm muscular strength allow the archers to relax when shooting, which in turn improves their performance (Lau, Ghafar, Hashim & Zulkifli, 2020; Humaid, 2014). Other than that, muscular endurance is defined as the ability of the muscle to maintain the force during certain periods of time (Ertan, 2017). As fatigue protocol occurred, an archer took a longer time during the aiming phase before he releases the arrow (Peljha, Michaelides & Collins, 2018). Contrary to archers who has great muscle endurance, they had taken short duration for aiming and shooting (Takai, Kubo, & Araki, 2012). In summary, archers must have strong muscles of the arms, chest, shoulders, and back to execute the repetitive movement of drawing the bowstring (Tinazci, 2011). Then, the implementation of resistance training may be beneficial in improving muscular strength and muscular endurance as it can also contribute to a better shooting performance in archery. As being agreed previously, resistance training is a form of 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). To our knowledge, Malaysia Olympic team was unable to contribute a medal in the last four editions; Beijing 2008, London 2012, Rio de Janeiro 2016 and Tokyo 2020 and even worse when Malaysia failed to qualify to the Paris 2024 (International Olympic Committee, 2021). Due to that, the coaches and archers have to seek the best answer on which training variables that can contribute the most in shooting performance. Therefore, in order to close the gap, this study intends to investigate the effects of 6-week different resistance training on shooting performance among archers.

MATERIAL AND METHOD

A total of 12 elite archers ($n = 12$) who participated in Sukan Malaysia (SUKMA), ranging between 18 - 23 years old, had been recruited at MSN Kedah to participate in this study by using purposive sampling technique and were free from any injury. Participants were randomly divided into two groups where the first group had undergone muscular strength training (MST = 6) while the second group had undergone muscular endurance training (MET = 6) for 12 sessions in 6 weeks (2 days/week). Before starting the training program, both groups had a baseline visit before performing the pre-test for

shooting performance. The participants were also given a consent form and a Physical Activity Readiness Questionnaire (PAR-Q 2022) before the test. The post-test data was taken after the 6-week intervention.

Training Program

Table 1: 6-Week Training Program for Muscular Strength

Exercises	Sessions (2d/wk)	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Dumbbell bench press	Session 1	5 kg x 5 reps x 3 sets		5 kg x 8 reps x 3 sets		7.5 kg x 3 reps x 3 sets	
	Session 2						
Dumbbell frontal press	Session 1	5 kg x 5 reps x 3 sets		5 kg x 8 reps x 3 sets		7.5 kg x 3 reps x 3 sets	
	Session 2						
EZ-bar upright row	Session 1	10 kg x 10 reps x 3 sets		15 kg x 10 reps x 3 sets		15 kg x 12 reps x 3 sets	
	Session 2						
TRX reverse pull-up	Session 1	BW x 10 reps x 3 sets		BW x 12 reps x 3 sets		BW x 15 reps x 3 sets	
	Session 2						
Weight plate squat	Session 1	5 kg x 10 reps x 3 sets		5 kg x 12 reps x 3 sets		10 kg x 10 reps x 3 sets	
	Session 2						

Table 2: 6-Week Training Program for Muscular Endurance

Exercises	Sessions (2d/wk)	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Dumbbell bench press	Session 1	5 kg x 10 reps x 3 sets		5 kg x 15 reps x 3 sets		5 kg x 20 reps x 3 sets	
	Session 2						
Dumbbell frontal press	Session 1	5 kg x 10 reps x 3 sets		5 kg x 15 reps x 3 sets		5 kg x 20 reps x 3 sets	
	Session 2						
EZ-bar upright row	Session 1	10 kg x 10 reps x 3 sets		15 kg x 8 reps x 3 sets		15 kg x 12 reps x 3 sets	
	Session 2						
TRX reverse pull-up	Session 1	BW x 10 reps x 3 sets		BW x 12 reps x 3 sets		BW x 15 reps x 3 sets	
	Session 2						
Weight plate squat	Session 1	5 kg x 10 reps x 3 sets		10 kg x 8 reps x 3 sets		10 kg x 12 reps x 3 sets	
	Session 2						

Shooting Test (Archery)

This study had conducted a shooting test for archers where the participants used standard Olympic recurve bow in both training and shooting tests. Each athlete used their own competition bow set in the training and shooting tests. Their archery shooting performance was evaluated from the total score achieved using international scoring system upon completing 36 arrows from 70-meter distance. 4 minutes were given for each end of 6 arrows with breaks were given between every end.

RESULT

Figure 1 shows that there was a statistically significant improvement in the shooting performance after 6-week of muscular strength training program from 279.17 ± 9.15 points to 285.33 ± 8.41 points ($p < .000$); an improvement of 6.17 ± 1.72 points for MSTG and also statistically significant improvement in the shooting performance after 6-week of muscular endurance training program from 287.17 ± 9.54 points to 299.17 ± 5.49 points ($p < .001$); an improvement of 12.00 ± 4.38 points for METG.

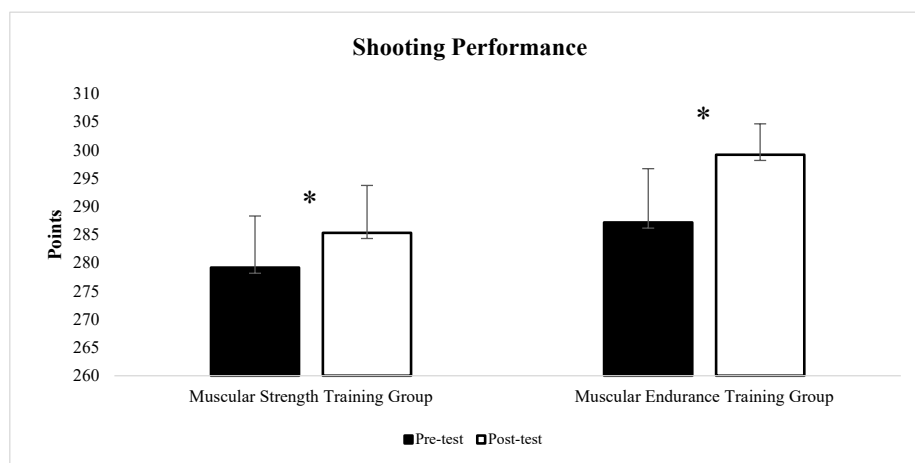


Figure 1. Pre- and Post-test Score for Muscular Strength Group and Muscular Endurance Group

DISCUSSION

The objective of this study is to investigate the effects of 6-week muscular strength and muscular endurance training program on shooting accuracy among archers. The result indicates that there was a significant improvement after 6-week of muscular strength training program on shooting points. The possible explanation might be due to the strength of the arm that is able to assist the archers in order to make a full draw or at least as far as the archer can draw before releasing the string to shoot. This had been agreed previously by Humaid (2014) where it was stated that the pull length has direct influence on archery achievement. In addition, the development of muscular strength can also help in controlling the string as being highlighted by previous studies (Juliana et al., 2019; Sezer, 2017) which mentioned that an archer will have a better control of the muscle to utilize the important muscle during a shooting if they have greater muscle strength. Furthermore, the upper body strength is essential to all archers as they might have to lift the bow while drawing the string. Moreover, the weight of the bow string pulls back ranges around 14 to 22 kg (Lau et al., 2020) where it is approximately 1440 kg in order to complete their 72 arrows during a tournament (Sezer, 2017) which is an advantage for those who have greater strength.

Apart from that, this study also found a significant improvement of shooting points after 6-week of muscular endurance training. The possible explanation might be due to the nature of the sport that needs the archers to pull the bow string repeatedly during a match. Due to this, it might be related to the ability of the archers to control their arm at prolonged period. This was being agreed by previous study which stated that controlling the arm, wrist and especially the fingers could be one of the critical elements in determining the success of every shot as the archers have to stabilize their body posture in every action to avoid any unwanted movement during a shooting (Sarro et al., 2020). Uncontrolled fingers, hand and arm will distort the target line during a shooting. The arrow and the bow can be held with the right or left hand if they are at the point of choice of hand. Ideally, the same force dominates both hands (Sezer, 2017; Kolayış et al., 2008; Gabriel et al., 2001; Gilbert et al., 1983). Other studies agreed that when an archer has a better control over the muscles, their shooting might become more consistent (Lo Presti et al., 2019; Simsek et al., 2019; 2018; Axford, 2017). According to the moment law in physics, when an object is subjected to more than one force, the object moves and is directed in the direction of the resultant of these forces. Arrow and bow are objects too; and they are directed according to the resultant of the forces applied by the fingers (Nicolay et al., 2005). This means that if the archer has strong muscles, especially related to their nature of sport performance, it will directly assist them in terms of ability to pull the string more and also ability to control his/her body posture during drawing which may produce better shooting accuracy. In addition, with good muscular endurance, the movements made by

an archer will remain constant and stable during the process of either training or at competitions (Kuswahyudi et al., 2021). However, determining which component is the best method remains unclear since there was no control group to be compared to and this has become the limitation of this study.

CONCLUSION

It can be concluded from the results that the effects of 6-week different resistance training protocol influence archers' shooting accuracy. In addition, both training protocol can enhance and contribute to a greater archery shooting performance as both training protocols improve after 6-week of training. It is suggested that coaches and archers as well, are recommended to focus on these two variables in order to improve the shooting performance of an archer. Future study is recommended to focus on young potential archers as it might help on talent development in archery.

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AUTHORS' CONTRIBUTION

Adnan, M., A., K., Japilus, S., J., M. and Ahmad, M., F. conceived and planned the experiments. Adnan, M., A., K. carried out the experiments and data preparation. Adnan, M., A., Shahudin, N., N. and Halim M., H., A. contributed to the interpretation of the results. Ahmad, M., F. took the lead in writing the manuscript. All authors provided critical feedback and helped to shape the research, analysis and manuscript.

CONFLICT OF INTEREST DECLARATION

We certify that there is no conflict of interest in the subject matter or materials discussed in this manuscript. We also certify that the article is the Authors' and Co-Authors' original work. The article has not received prior publication and is not under consideration for publication elsewhere. This research/manuscript has not been submitted for publication nor has it been published in whole or in part elsewhere. We testify to the fact that all Authors have contributed significantly to the work, validity and legitimacy of the data and its interpretation for submission to Jurnal Intelek.

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