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A Study of Endurance Training Methods and Their Effects on Archery Athletes

By

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Abstract

Muscular endurance is the ability of muscles to maintain repetitive movements against resistance over a certain period of time. This training method has the same characteristics as the basic techniques in archery where the athlete must hold and pull the bow to hit the target precisely and accurately. The method in this article uses the library research method, namely a method of understanding and studying theories from various literature related to the research. There are four stages of library study in research, namely preparing the necessary equipment, preparing a working bibliography, organizing time and reading or recording research material. This data collection uses the method of searching for sources and compiling them from various sources, for example books, journals and research that has been carried out. Studies show that strength endurance training can increase the ability of arm muscles to endure for longer periods of time during training sessions or competitions. This exercise involves a combination of strength and endurance, which is important for stability and precision in archery. Studies show that strength endurance training can increase the ability of arm muscles to endure for longer periods of time during training sessions or competitions. This exercise involves a combination of strength and endurance, which is important for stability and precision in archery.

Keywords: Archery Athletes, Strength Endurance, Training Methods

INTRODUCTION

Archery is an activity or sport in which participants use a bow to shoot arrows at a target. According to (Saparuddin, 2019) Archery is a combination of sport and art. It is considered a sport because it uses functional muscles such as the trapezius, triceps, and deltoids, and also requires physical endurance. At the international level, archery is divided into two divisions: recurve and compound. In Indonesia, there are three divisions: recurve, compound, and standard bow. The objectives of archery include accuracy and concentration, skill and technique, competition and achievement, health and fitness, recreation and entertainment, as well as tradition and culture. Through these objectives, archery is not only a competitive sport but also an activity that supports physical, mental, and social development. According to (Vanagosi, 2015) Archery is a target sport with the ultimate goal of shooting arrows accurately at a target face.

In archery, there are several aspects that must be considered according to (Susanto, 2015) The physical components required in archery include: (1) physical condition, (2) muscle strength, (3) muscle endurance, and (4) technique. Being in good physical condition is very helpful in aiming at the target face in archery. The most dominant physical components in holding and pulling the bow are arm muscle strength and arm and shoulder muscle endurance. According to (Yenni et al., 2012) Otot – otot yang paling penting dan spesifik diperlukan untuk menarik dan menahan berat tarikan busur ialah otot – otot jari trapezius, bisep, rhomboid, deltoid, dan trisep.

Muscular endurance is the ability of muscles to perform repeated contractions or maintain contractions over a long period of time without significant fatigue. According to (Larasati et al., 2018) Muscular endurance is the ability of muscles to maintain repetitive movements against resistance for a certain period of time. Other experts say that muscular endurance is one component of physical condition in improving physical fitness (Abdillah et al., 2021). This training method has the same characteristics as the basic techniques in archery, where athletes must hold and pull the bowstring to hit the target accurately and precisely. Based on

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the above explanation, the strength endurance training method will be the independent variable tested for its effect on arm muscle endurance. Thus, the purpose of this study is to determine whether there is a significant effect of the strength endurance training method on the arm muscle endurance of archery athletes.

RESEARCH METHOD

The method used in this article is library research, which involves understanding and studying theories from various literature related to the research. There are four stages of library research in this study: preparing the necessary tools, preparing a working bibliography, organizing time, and reading or taking notes on research materials. Data collection involves searching for sources and compiling information from various sources, such as books, journals, and previous research studies. The literature obtained from these references is analyzed critically and in depth to support the research propositions and ideas (Adlini et al., 2022).

RESULTS AND DISCUSSION

Based on the literature review conducted, several studies indicate that strength endurance training has a significant effect on improving arm muscle endurance in archery athletes. The following are the main findings from various literature sources:

1. Increased Arm Muscle Endurance

Based on the results of the literature review revealed that strenght endurance training proved to be very effective in improving the ability of arm muscles, arm muscles can work for a long duration, both during training sessions and during competition. The exercises that combine strength and endurance can support arm muscle stability. Therefore, the athlete is able to maintain the position of pulling the bow without quickly experiencing fatigue. This is also reinforced in a study conducted by Muslim, Saripin, and Agust (2016) revealed that training with a focus on muscle endurance will help reduce fatigue so that the consistency of archery techniques can be maintained throughout the match.

In addition, arm muscle endurance also has an impact on upper body stability. This is in line with a study conducted Yachsie et al. (2021) revealed that with strong and durable arm muscles, athletes are better able to maintain optimal posture when drawing the bow, resulting in more precise shots. When muscle endurance decreases, muscle tremors will occur and potentially affect the accuracy of the shot (Saputra 2024). To increase muscle endurance, strength endurance programs must be prepared periodically and individually. Adjustments to the load, reps, and training intervals need to be tailored to the physical abilities of each athlete so that muscle adaptation is maximized without the risk of overtraining. With the right training pattern, arm muscle endurance can support optimal technical performance.

2. Physiological Adaptation

The results of the literature study also show that increasing arm muscle endurance has a significant impact on improving the overall performance of archery athletes. Athletes with strong arm muscles and good endurance will be more stable in pulling and holding the bow, thus supporting more consistent shot accuracy (Deviyanti et al., 2022). This had a direct impact on the final result of the match. This has a direct impact on the final result of the match, as stable muscle endurance helps athletes maintain proper shooting form throughout long training sessions or competitive rounds. Furthermore, improved arm muscle endurance reduces the risk of early fatigue, which is often a major factor in declining shot quality during critical moments in a competition. With better endurance, archers can also handle psychological pressure more effectively, because physical readiness supports mental focus and confidence. Therefore, consistent strength endurance training for the arm muscles should be considered a key component in an archer's overall conditioning program to achieve optimal performance and competitive advantage.

According to Warni, Arifin, and Bastian (2017) revealed that strength endurance training also increases local muscle VO2max. With better oxygen uptake ability, arm muscles can work more optimally and delay the onset of fatigue. This increase in muscle aerobic capacity supports repetitive bow-drawing activities without degrading shot quality. In addition, a study conducted Misbahunnur (2017) revealed that high-rep training with moderate weights triggers the dominant activation of type 1 (slow-twitch) muscle fibers. These muscle fibers play a major role in static activities that require long-term endurance. Thus, the physiological adaptations that occur through strength endurance training support arm muscle endurance according to the demands of archery movements.

3. Overall Performance Improvement

Literature studies also show that increasing arm muscle endurance has a significant impact on improving the overall performance of archery athletes. This is in line with the study conducted Deviyanti et al. (2022) states that athletes with strong arm muscles and good endurance will be more stable in pulling and holding the bow, thus supporting more consistent shot accuracy, and this can have a direct impact on the final outcome of the match. In addition, athletes who possess better arm muscle endurance are less likely to experience muscle tremors or fatigue during the crucial phases of a competition, allowing them to maintain proper shooting posture and concentration for a longer period. This endurance advantage also helps archers to execute repeated shots with the same level of power and precision, even in high-pressure conditions or extended matches. Therefore, consistent training to develop arm muscle strength and endurance should be prioritized in archery programs to ensure athletes can perform optimally, minimize performance drops, and maintain a high level of technical execution throughout the competition.

In addition to physical aspects, increasing arm muscle endurance also has an impact on the mental readiness of athletes. Therefore, athletes with optimal physical condition tend to have higher confidence when competing (Nisa & Jannah, 2021; Purnamasari et al., 2022). Thus, this confidence is important to support emotional control and concentration in

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demanding match situations (Nursaba et al., 2024; Saharullah, 2020). However, performance improvement does not rely solely on physical training but emphasizes the importance of integrating muscular endurance training with technical training, strategy, and mental coaching (Komarudin et al., 2024). This approach will result in balanced physical and mental readiness so that athletes can perform optimally in every competition.

4. Exercises to Train Arm Muscles

Dumbbell-Thera Band training can be an effective alternative to improve arm muscle endurance in archery athletes. This was revealed in the study Teofa et al. (2019) explains that this method utilizes a combination of dumbbell load and Thera Band elasticity to train strength and endurance simultaneously. This exercise is especially useful when athletes do not have direct access to a bow and arrow. Thus, the Dumbbell-Thera Band movement variations can be adapted to the bow pulling motion pattern, so that the training stimulus remains relevant to the needs of archery. Exercises such as shoulder press, rowing, and bicep curl with Thera Band support functional strengthening of the shoulder and arm muscles. In addition, the study conducted Adani et al. (2017) revealed that Dumbbell-Thera Band training can be combined with proprioceptive training to improve postural stability. Good shoulder and upper back stability will support a steady aiming position, thus having a positive impact on shot accuracy.

Push-up and pull-up exercises are used as recommendations for exercises to support arm muscle endurance in archery athletes. In the study Saparuddin (2019) revealed that pull-ups are more relevant for strengthening the bowstring muscles as the movement pattern is similar to that of pulling a bowstring. While push-ups are beneficial for strengthening the chest and forearm muscles (Munanda 2016). This is in line with a study conducted Nasrulloh et al., (2018) revealed that pull-up exercises performed progressively can improve the isometric endurance of the arm and upper back muscles. The ability to withstand these isometric contractions is essential for the stability of drawing the bow in the aiming position. A combination of push-ups and pull-ups provides more optimal results than either exercise alone. This combination helps to build muscle strength in a balanced manner, supports a stable posture, and improves functional arm muscle endurance.

Based on the results of the literature review, it shows that strength endurance training has a significant impact on increasing arm muscle endurance in archery athletes. The results of this study reinforce the theory that archery, although seemingly static, demands a high muscle endurance component. Thus, maintained arm muscle endurance allows athletes to maintain the stability of pulling a bow for a long time without a decrease in shot quality. This is in accordance with the study conducted Septiana et al., (2020) who revealed that muscle endurance is the main foundation for the stability of basic archery techniques.

In addition, study findings on aspects of physiological adaptation can have an impact on the role of strength endurance training in triggering changes in the capillarization system or what can be called the event of rising or falling liquid in small vessels or pores and this can optimize muscle oxygen use. Therefore, this can support muscle work to remain optimal in the dominant isometric phase in archery. And cause an increase in local muscle VO2max and the ability of slow-twitch muscle fibers to contribute to better endurance (Fenanlampir, 2020). This proves that training not only focuses on increasing maximal strength, but also on the metabolic efficiency of the muscles.

Improving arm muscle endurance has been shown to be closely related to improving the overall performance of archery athletes. Athletes who have good arm muscle strength and endurance will be more stable in pulling and holding the bow, thus increasing the chance of shot accuracy (Deviyanti et al., 2022). Not only this, but good physical readiness also fosters confidence and helps control emotions in the arena (Pratama & Utami, 2024). The results of this study confirm that physical and mental aspects support each other for optimal performance.

Dumbbell-Thera Band training has proven to be an effective alternative that is easy to implement, especially when athletes do not have access to archery equipment. Based on the study Teofa et al. (2019) revealed that this exercise not only improves arm muscle endurance but also supports shoulder and upper back stability. And it can combine proprioceptive training to maximize postural stability. This emphasizes the importance of varying training methods to remain relevant to the specific movement needs of archery. In addition to the Dumbbell-Thera Band, basic exercises such as pull-ups have specific benefits for strengthening the bow-pulling muscles. This is in line with a study conducted (Saparuddin, 2019) proved that pull-ups provide a motion that is more similar to pulling a bowstring than push-ups. The combination of push-ups and pull-ups together is also recommended for balanced strengthening of the forearms and back muscles (Lengkana & Muhtar, 2021; Putra et al., 2022; Widiyono et al., 2022).

Although research results support the effectiveness of strength endurance training, implementation in the field must still pay attention to the principles of periodization and individualization. Trainers need to design training programs in a gradual and measurable manner so that the resulting adaptation is optimal and the risk of overtraining can be prevented (Putra et al., 2022). In addition, arm muscle endurance training must also be integrated with training in aiming techniques, tactical strategies, and mental strengthening. With this holistic approach, improving the performance of archery athletes can be achieved maximally, sustainably, and safely.

CONCLUSION

Based on the results of understanding the theories from the literature related to this study, there is a significant effect of strength endurance training on the arm muscle endurance of archery athletes, thereby supporting the performance of

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archery athletes in resisting and pulling arrows in an archery competition.

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