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Validity and reliability of archery sport arm muscle endurance training program based on body weight training

Validez y confiabilidad del programa de entrenamiento de resistencia de los músculos del brazo en deportes de tiro con arco basado en el entrenamiento con peso corporal

*Betrix Teofa Perkasa Wibafied Billy Yachsie, **Doni Pranata, *Galih Dewanti, ***Putri Famelia, ****Zhanneta Kozina
*Universitas Negeri Yogyakarta (Indonesia), **Universitas Tanjungpura (Indonesia), ***Hasselt University (Belgia), ****H.S. Skovoroda Kharkiv National Pedagogical University (Ukraina)

Resumen. El tiro con arco es un deporte que consiste en disparar flechas utilizando un arco. El aspecto físico más importante del tiro con arco es la resistencia. Propósito: Este estudio tiene como objetivo examinar la validez y confiabilidad de los contenidos del programa de entrenamiento de resistencia de los músculos del brazo. Los participantes involucrados en este estudio fueron 5 preparadores físicos y 2 entrenadores de tiro con arco con licencia nacional. Algunos documentos también se utilizan en esta investigación. El enfoque utilizado es un enfoque mixto cualitativo y cuantitativo. Este estudio se dividió en cuatro etapas: (1) análisis cualitativo de libros electrónicos, libros de texto y artículos relacionados, (2) evaluación de programas utilizando la técnica Delphi, que involucra a expertos calificando cuestionarios en una escala de 1 a 5 hasta obtener un consenso, (3) pruebas de validez de contenido utilizando la fórmula CVR, (4) pruebas de confiabilidad utilizando alfa de Cronbach e ICC. Validez de contenido y valor alfa de Cronbach, con base en los hallazgos se puede afirmar que el programa tiene un valor de validez y confiabilidad muy bueno y es digno de ser impartido a deportistas. Con base en los resultados de la prueba de validez de contenido y la prueba de confiabilidad se puede afirmar que el programa de entrenamiento de resistencia de los músculos del brazo tiene un buen valor, esto demuestra que se puede aplicar en el entrenamiento de atletas de tiro con arco.
Palabras clave: Resistencia de los músculos del brazo, validez, confiabilidad, tiro con arco.

Abstract. Archery is a sport that shoots arrows using a bow. The most important physical aspect of archery is endurance. Purpose: This study aims to examine the validity and reliability of the contents of the arm muscle endurance training program. The participants involved in this study were 5 physical trainers and 2 nationally licensed archery trainers. Some documents are also used in this research. The approach used is a mixed qualitative and quantitative approach. This study was divided into four stages: (1) qualitatively analyzing e-books, textbooks, and related articles, (2) evaluating programs using the Delphi technique, which involves experts rating questionnaires on a scale of 1 to 5 until a consensus is obtained, (3) content validity testing using the CVR formula, (4) reliability testing using Cronbach alpha and ICC. Content validity and Cronbach alpha value, based on the findings it can be stated that the program has a very good validity and reliability value and is worthy of being given to athletes. Based on the results of the content validity test and the reliability test it can be stated that the arm muscle endurance training program has a good value, this shows that it can be applied when training archery athletes.
Keywords : Arm Muscle Endurance, Validity, Reliability, Archery.

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Betrix
betrixbilly@uny.ac.id

Introduction

Achievement in archery requires supporting factors, one of which is the physical condition compo20nent. The aim of forming optimal physical components can help increase the potential for functional performance of athletes and improve biomotor performance of athletes based on biomotor related to each branch (Lu & Zhong, 2023). The physical component of archery has to do with arm muscle endurance, arm muscle endurance is an important component in archery and plays an important role in the bow-drawing process (Baifa et al., 2023). Archery ability is defined as a person's ability to shoot arrows at certain targets with precise accuracy, therefore it requires stable muscle strength that can fulfill optimal movements so that they can release arrows right on target (Sarro et al., 2021).

There are several relationships that can create shooting accuracy in the sport of archery, this is evidenced by (Hamilton et al., 2021). that there is a relationship between arm muscle endurance, body position balance, bow stability and the accuracy level of a person in releasing arrows. The balance of an athlete's body position is influenced by several factors, including the influence of an exercise program that specifically trains to maintain a position in a balanced form that is supported by an athlete's optimal physiological response (Zemková & Kováčiková, 2022). This balance explicitly refers to static balance (Zemková, 2014). Because there are 2 types of balance itself, namely static balance and dynamic balance (Varovic et al., 2023). On the other hand, the next factor is muscle endurance, the ability of the muscles in the arms to carry out strenuous activities for long periods of time (Ergen et al., 2021). Endurance is a combination of the physical conditions of strength and endurance (Graf et al., 2023). Thus, to produce maximum arm endurance, it takes a long time with repeated repetition (Haugen et al., 2023). In addition, there are factors that can support the creation of good muscle endurance, including: muscle endurance training, muscle contraction, body weight, age, gender, and glycogen reserves (Abdoshahi et al., 2023).

The archery process from the initial pull to the release requires good arm muscle endurance. Because patterned exercises only use one side of the body (unilateral) and the position of maintaining the body consistently (asymmetry),

which causes injury or decreased athlete performance. that is, the lack of arm muscle endurance will interfere with the accuracy of archery which will affect the performance of most athletes. As stated in previous studies, most archers have tremors in the bow arm. Tremor is a condition in which the hands or limbs vibrate when given a load or at rest caused by the impact of fatigue doing physical activity (Kaňáková et al., 2022). In addition, the symptoms of tremor make it difficult for athletes to move limbs, both legs, hands and mouth when speaking which is marked by shaking and difficulty gripping (A. Kuch et al., 2020). Therefore, to minimize this incident, an archery athlete is required to have an optimal physical condition, especially good muscle endurance (Knechtle et al., 2012).

In archery, endurance is a critical variable that must be managed to get good results. When one hand dynamically pulls the strings in archery, the other hand must push the bow with the elbow extended toward the target and hold it statically until the arrow is released. In this case, an athlete tries to maintain as much endurance as possible by maintaining the posture of the arms and body when pulling the bow and aiming at the target [15] and according to [16] archery requires good upper body control, therefore endurance is a very important physical characteristic to get the best results. At present there are gaps, especially in the application of physical training for archery athletes, where the exposure of the dominant muscles is not prioritized causing less than optimal results. Each sport has its own characteristics and involves different dominant muscles in each branch (Adams et al., 2023). To get maximum results, of course, requires training methods that are explicitly branched (Baifa et al., 2023). The benefit of physical training that has suitability based on branching is that it can create movements that are carried out by athletes effectively and efficiently, this is because it is supported by muscles that have been trained continuously (Abdoshahi et al., 2023).

In archery alone, the plan for arm muscle endurance training still only emphasizes isometric muscle movement or contraction, with a slight variation of isotonic muscle contraction exercises. Good range of motion exercises are defined as static exercises that require proper strength, upper body strength. On the other hand, there is an inaccurate assumption that archery does not require strong physical condition and is a minor activity. However, the physical condition in archery is an important element for achieving achievement. One of the things that every athlete must have in developing and improving sports performance optimally is called physical condition, the physical condition that must be developed and improved must be in accordance with the needs and characteristics of each sport, especially in archery (Josse, 2023). Archery has dominant physical characteristics, including flexibility, strength, and muscle endurance (Hrysomallis, 2011). Therefore, having a high physical condition needs to be carried out based on a strict physical training program so that archery performance increases (Hamilton et al., 2021). This theory is reinforced by the opinion (Andrian Kuch et al., 2023). that the physical condition component is very important for good results for archery. Today, many training methods have been developed to improve core physical endurance.

The suggested solution to this problem is in accordance with theoretical studies, which state that archery physical training emphasizes hand-eye coordination and muscle endurance. As a result, before competing, core muscle training is needed. The core muscles consist of the deltoid, rhomboid, levator scapula , and trapezius are the main muscle groups used for back and shoulder strain when used properly, hence responsible for holding the bow back in full tension. The structure of the muscles depends on the size of the muscle fibers that make up the structure of the muscle groups, therefore the endurance of the arm muscles is an ability that is influenced by muscle contractions. Five major muscles produce flexion and extension in the elbow joint. The muscles that play a role are the brachialis, brachioradialis, biceps brachii, tricepsbrachii, and anconeus. Four muscles responsible for supination and pronation of the forearm. The other three muscles involved with forearm movement are the supinatoris muscle, the pronator quadratus , and pronator teres.

As indicated in the explanation, the organization and development of a proper training program is very important. The effect of this exercise on the performance of basic archery skills, especially arm muscle endurance, is a study on this topic that focuses on experimental testing. Since the aim of this study was to create an archery training program that addresses the dominant muscles in archery, the development process should include content validity and reliability assessments carried out by qualified specialists before the program can be used by athletes. Thus the purpose of this research is to see how accurate and reliable the training program materials that have been prepared and developed are.

Method

Study participants

Physical conditioning experts and 5 nationally licensed archery trainers with the required documents/purposive sampling (having certificates, understanding various training programs, having expertise in pure sports coaching, and being former archery athletes). The research location is in the Indonesia.

Research design

The method used is research and development where this type of method develops, modifies, and validates existing models to provide solutions. This study uses a mixed qualitative and quantitative approach.

Statistical analysis

There are 4 stages carried out in this research. Stage (1) is the stage where researchers review articles, e-books, and textbooks to create a balanced training program for archery

athletes. Stage (2) is the stage of quantitative program evaluation using the Delphi technique by seven experts based on the results of a questionnaire with a rating scale of 1 to 5 until a consensus is reached. Stage (3) the researcher uses the Content Validity Ratio (CVR) formula to calculate the results of the expert's assessment to determine the value of the content validity of the program produced in the third stage. In stage (4) the researcher used SPSS 23 to perform a reliability test using Cronbach alpha and inter-rater.

Results

Based on the results of document analysis by 7 experts in textbooks, e-books, and related articles, an archery balance training program was produced with CVR results of 0.71-1.00. The results of program development and analysis are presented as follows:

Table 1.
Results of the Development of an Arm Muscle Endurance Training Program

Week	Meeting	Training material	Training Dosage
1-6	1-18	Procedures and equipment Athletes are guided to jog and do dynamic static stretches. Indoor/outdoor court equipment, mats, body support boards, hanging poles, long chairs.	Guide trainer Warm up/stretch for 5 minutes
		Warm-up jogging. Static and dynamic flexibility.	Warm-up/stretch for 5-10 minutes
		Play Workout 1 Reverse grip pull-ups Hanging knee pull-up Behind the neck pull up Pull-ups Side to side pull-ups Wide grip rear pull-ups Bench pull-ups	Slow/moderate rhythm. intensity 60% -75% RM. repetitions 4-5-6-7-8. Frequency 3-4-5. Recovery 3-5 minutes.
		Play Workout 2 Kneeling push-ups Pike Push-ups Hindu Push-ups Delt tab push-ups Sidekick push-ups Archery push-ups Forearms push-ups	Slow/moderate rhythm. intensity 60% -75% RM. repetitions 4-5-6-7-8. Frequency 3-4-5. Recovery 3-5 minutes.
		Cool down	Cooling down/evaluation for 5-7 minutes

Note: form of arm muscle endurance training program for 18 meetings held 6 weeks.

Table 2.
Results of Content Validity of the Arm Muscle Endurance Training Program

No	indicator	Expert Number							
		1	2	3	4	5	6	7	CVR
1	The intensity applied follows the goal for arm muscle endurance training	1	1	1	1	1	1	1	1.00
2	The number of repetitions applied follows the goal of increasing arm muscle endurance	0	1	1	1	1	1	1	0.71
3	The frequency of exercises applied follows the guidelines for arm muscle endurance training	1	1	0	1	1	1	1	0.71
4	The rhythm that is applied follows the aim of arm muscle endurance training	1	1	1	1	1	1	1	1.00
5	The number of sets applied follows the aim of arm muscle endurance training	1	1	1	1	1	1	1	1.00
6	The intervals that are applied follow the goals for arm muscle endurance training	1	1	1	1	1	1	1	1.00
7	The applied recovery follows the restoration of the energy system	1	0	1	1	1	1	1	0.71
8	This type of exercise is quite programmed and easy for athletes to do	1	1	1	0	1	1	1	0.71

Note: the results of the reliability test from the results of the questionnaire for textbook experts/trainers.

Table 3.
Results of Reliability Analysis of Correlation Coefficients Between Classes (ICC)

Interclass Correlation	Single Measures	Average Measures
	0.187	0.342
95% CI		
Lowerbound	0.028	0.332
Upperbound	0.498	0.786
Value	1.876	1.876
F Test with True Value 0		
Df1	7	7
Df2	42	42
Sig	0.000	0.000

Note: correlation results between related articles, e-books, arm muscle endurance training programs and textbook/trainer expert questionnaires.

Analysis using the reliability of the correlation coefficient between classes (ICC) shows that the value of single action agreement is 0.187 and the average agreement value is 0.342. These results are in accordance with the criteria which states that if the agreement value is more than 0.75 then the data is reliable.

Discussion

Most sports require adequate physical condition to achieve high performance. According to (Madureira et al., 2023). a good level of physical fitness is needed by athletes regardless of the type of sport. Although archery is not a sport that requires high physicality, it does require a high level of physical fitness. It is the trainer's responsibility to establish a physical training program that adheres to the training principles. There are several training principles that must be considered by trainers including overload, consistency, specification, progressiveness, individuality, and stability (Khalid et al., 2022). Exercise programs that must be considered must also be adapted to specific sports which of course have differences between other sports (Prosoli et al., 2021). And for archery itself, the dominant biomotors are strength, endurance, speed, coordination, flexibility (Fitrian et al., 2023; Pavlović et al., 2022; Yachsie et al., 2023).

The task of the coach has the responsibility to regulate the athlete's mental condition and develop a good training

program. The training program certainly has a major contribution to improving physically and psychologically in archery (Hung et al., 2021). A good training program is a training program that is made based on the rules of making a training program, each phase must pay attention to what goals and achievements must be fulfilled and meet the set time (Aslan & Yoncalık, 2023; Andrian Kuch et al., 2023). Broadly speaking, the training program periods that must be considered are the preparation, competition, and transition periods (Song et al., 2023). Other studies support this idea, suggesting that the best way to develop a sport and achieve maximum levels of achievement is to use a structured and graded training program (Xu et al., 2023). A structured training program is an exercise program that is made in detail from general to specific, and covers all aspects that must be improved, while graded is a training program that is arranged from easy to difficult (Zádrapa, 2022). Arm muscle endurance is one of the most important physical characteristics of archery. where endurance is highly correlated with strength, which means that arm muscle endurance and low functional strength can affect the release of arrows and the quality of coordination for precise archery. Therefore, the stability of archery is very dependent on a good level of arm muscle endurance.

Planning an exercise program is a lot like a doctor giving medication to a patient, with the dosage adjusted for everyone. This is like how a sports coach must know the appropriate level of movement for each athlete. Furthermore, the level of heterogeneity in training is significant where the results are strongly supported by experts to make exercises tested and calculated by statistical analysis so that the results look valid and appropriate when given to athletes. Athletes will be more enthusiastic in carrying out exercises if the training program is planned with good variations in motion. And this is also because in the training program there is psychological preparation contained in the training program and must always be considered by the coaches, psychology must always be considered to support the creation of maximum achievement athletes (Hung et al., 2021).

On the other hand, from an athlete's physical point of view, in archery, the stability of excellent upper limb strength and core muscles is also influenced by the endurance of the arm muscles (Bowden, 2021). Therefore, coaches must plan or develop training programs to improve the balance of archery athletes. The balance in question must be considered and stated in the preparation period for the general and special preparatory phases (Baifa et al., 2023). The training program created It is necessary to validate the contents of the training program that has been prepared and aims to see the level of reliability of the training program based on expert judgment before making the training program (Abdoshahi et al., 2023). This finding is in line with what happened in the field that an exercise program can be relied upon at least half of the experts consider the indicator to be important.

Some of the questions asked during subject interviews included "The intensity applied follows the goal for arm muscle endurance training?". The answers of several subjects all followed the goals for arm muscle endurance training and followed the number of repetitions applied. "The frequency of training applied follows the guidelines for arm muscle endurance training?". The answers of some subjects answered following the guidelines for arm muscle endurance training and the number of sets applied according to the purpose of arm muscle endurance training. "The recovery applied follows the recovery of the energy system?". The answers of some subjects answered yes the recovery applied followed the recovery of the energy system.

Based on the findings, all indicators get the maximum score on the results of filling in by experts, which is 1.00. Based on the results of content validity testing, it shows that the compiled program has good validity. It is said to be important or has strong content validity if the CVR score is greater than 0 while the reliability test on this result results that the program made is reliable, then a measuring tool can be said to have good reliability. The compiled program has been proven valid. However, a 6-week trial with the exercise program is needed to see improvements for the exercise program to prove more reliable.

Conclusion

As seen in the findings obtained, the balance training program in archery has accurate content validity and reliability. Thus, this training program is recommended for archery athletes at the beginner level. In other words, archery athletes can use training programs to increase arm muscle endurance. However, this training program needs to be understood and carried out routinely in 18 meetings so that the effectiveness and accuracy in delivering the training program can be seen.

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Datos de los/as autores/as y traductor/a:

Betrix	betrixbilly@uny.ac.id	Autor/a
Doni Pranata	doni.pranata@fkip.untan.ac.id	Autor/a - Traductor/a
Galih Dewanti	galih.dewanti@uny.ac.id	Autor/a - Traductor/a
Putri Famelia	putriifameliaa@gmail.com	Autor/a - Traductor/a
Zhanneta Kozina	zhanneta.kozina@gmail.com	Autor/a - Traductor/a