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DEVELOPMENT OF RESISTANCE-BASED ARCHERY TRAINING MODELS FOR ATHLETES AGED 13-15 YEARS

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Abstract: The purpose of this study was to produce a resistance-based archery training model for athletes aged 13-15 years. The method used in this research is Research and Development. The study was conducted at DSR Archery Club Depok City and the research subjects were athletes aged 13-15 years. This research begins with needs analysis, product planning, development, implementation, and evaluation. The instruments used were the 30 M Archery Test in the sport of archery, an analysis of the need for in-depth interviews to coaches at the archery club, and an assessment questionnaire to experts to test the validity of variations in the training model. Based on research data consisting of needs analysis, product design, expert validation, small and large group trials, and effectiveness tests. The conclusion is first, a resistance-based archery training model for athletes aged 13-15 years can be developed and applied in training archery skills and muscle strength training. Second, the exercise model developed based on research data obtained effective results for athletes aged 13-15 years.

Kata kunci: Exercise Models; Physical; Archery; Resistance Based

INTRODUCTION

Archery has different characteristics from other sports. This archery sport requires a subtle touch of the soul, patience, tenacity, concentration, and high mental endurance. Therefore, a true archer must have basic techniques, movement mechanisms, mentality, and good physical condition as a complete unit that must be possessed. As Tinazci, (2011) says that comparatively, archery demands very specific strength and endurance, both during training and competition. When compared to other strengths or durability, demands for accurate appearance. Therefore, to support the development of a good archery branch, it is necessary to have a coaching pattern that is directed at achieving achievements.

The achievements of archery in Indonesia today are experiencing unstable ups and downs, so there is a need for early achievement development that must be managed properly and correctly. There are four aspects of training that need to be considered and trained carefully by athletes, namely physical training, technical training, tactical training, and mental training (Subarjah, 2012). From these four aspects, it can be understood that the development of sports achievement needs to be supported by supporting aspects, one of which is the mastery of physical abilities (Harsono, 2015).

Physical condition is a factor that is demanded in every sport because basically, physical condition supports the appearance of athletes when competing. As revealed by Anggriawan, (2015) athletes who have a good physical condition, physiologically the athlete does not experience significant fatigue in the match, even according to Puspitasari, (2019) will avoid injuries that can interfere with their appearance. Likewise in the sport of archery, excellent physical condition is very important because it is to pull and hold the weight of the bow while shooting. In addition to having to be able to pull the weight of the bow, the athlete must be able to withstand the load of the bow at the time of full pull which determines the arrow's shot.

Studies in archery put special stress on the cardiovascular system of archers during repeated shooting, particularly during the competition (Carrillo et al., 2011). There are changes in heart rate before and during archery influenced by physiological, psychological factors, some muscle pressure, limited time, repeated shooting of the whole body against the chest and shoulder muscles. Especially when pulling the bowstring, the muscles will experience isotonic contractions, namely in the initial pull (primary draw), then when fully pulled the arm pulling the bowstring must reach below the chin and the bowstring touches the tip of the nose (anchoring) and the arm holding the bow must completely lock as well as the pulling arm so that an isometric contraction occurs. So it can be said that the dominant physical components needed in archery are strength and endurance.

Strength is the ability of muscles to contract to generate tension against a prisoner (Yudiana, Subardjah, & Juliantine, 2009). While endurance is a person's ability to do work for a relatively long time (Yudiana et al., 2009). Therefore, strength and endurance in archery are some of the aspects to increase the stabilization of accuracy when archery. Therefore, to support the function of body movement when doing archery sports activities, strength and endurance are needed which refers to the entire motion system when archery.

Exercise is a process to develop the ability of physical activity or physical condition that is carried out systematically and progressively improved to maintain and increase the degree of physical fitness in order to achieve optimal physical work. As Harsono, (2015) said that the factors that influence the improvement of an athlete's achievement and skills are exercises that are carried out repeatedly, increasing the number of training loads and the intensity of the training.

The purpose of training is to help athletes improve skills, and psychological qualities to improve their performance in competition. Exercise must be guided by the correct theory and principles of exercise so that the expected sports achievements can be achieved. (Pate et al., 2007). In the world of education in big countries, training and educating have left the old ways which are less efficient and less effective. With the help of technology, we can start training with the help of technology which has changed the latest ways to train and is more efficient.

Today a form of exercise that is being developed and is often done to increase strength (strength) is resistance training (resistance training). "Resistance training is specifically designed to increase strength, power, and muscular endurance when designing a resistance training program, you must first consider the muscle group to wish to train, then selected resistance exercise accordingly" (Wilmore, Costil, 1994). Based on the description above, it can be explained that resistance training is an exercise specifically designed to increase muscle strength and endurance. One of the resistance or resistance that can be used is to use rubber. Rubber resistance is one of the tools designed to help improve physical abilities, especially strength and durability.

Based on the results of observations made by researchers in the field, the exercises carried out focused only on technical training and only used physical exercises in the form of push-ups and pull-ups. Perhaps this has caused the decline in the performance of one of the clubs in the city of Depok, West Java, namely Defrizal Siregar Archery Club (DSR Archery Club). DSR archery club has participated in a number of prestigious regional, regional, national and international championships which are held every year. However, recently (DSR Archery Club) is experiencing a decline in the level of achievement, resulting in a reduction in the contribution of gold medals and trophies. So this is what causes researchers to be interested in conducting research on why the club (DSR Archery Club) has decreased the level of achievement in participating in various existing championships. This is supported by the results of interviews with several DSR Archery Club coaches, the coach said that the decline in athlete achievement was caused by many things, including; mental competition, lack of training schedule, boring training innovation, lack of physical exercise resulting in decreased athlete performance, because physical exercise is a fundamental aspect that must be mastered by athletes, because archery really requires strength and

muscle endurance, especially to pull and hold bow loads.

Based on the statement above, the researcher considers the need for innovation and creativity in archery training models. The importance of innovation and good creativity in the process of resistance-based archery training for the beginner athlete, so that the coach can give a new nuance to the athlete so that the athlete does not get bored with the archery training material that already exists. Therefore, in this study, researchers took the initiative to develop a resistance-based archery training model for athletes. Therefore, researchers will develop a resistance-based archery training model product for beginner athletes.

Research on the sport of archery itself has been mostly analyzing the effects of exercise, physiological aspects, tests and measurements as well as biomechanics. As research conducted by Laishram et al., (2008) entitled effects of strength training and jatamansi on reducing hand tremor amongst archers related to comparing the effects of strength training (shoulder girdle and respiratory muscles) and drugs (Jatamansi) to reduce hand tremor in archer. Meanwhile, what was done by Kim, (2008) the effect of balance exercises on postural control and shooting recordings in archers with a study entitled the effect of balance exercise on postural control and shooting records in archers. 2016) entitled Effects of Pilates core stability exercises on the balance abilities of archers in researching the effect of Pilates core stability exercises (PCS) on dynamic and static balance. Next (Aryani, n.d.) examined the plank exercise program on arm muscle endurance and archery accuracy. Sezer, (2017) the impact of handgrip strength exercises on the target shooting accuracy score for archers in his research on the effect of handgrip strength training on target shooting accuracy scores for male archers. While recently Dhawale, (2018) entitled Effect of Upper Extremity Plyometric Training on Strength and Accuracy in Archery Players. The aim of this study was to investigate the effect of upper extremity plyometrics on strength and accuracy in archers conducted for 3 days a week to 6 weeks. This is supported by Sharma et al., (2015) Effectiveness of six weeks training on static strength of archery players discussed to compare the effectiveness of six weeks training on static strength of archer players and also Humaid, (2014) Influence of Arm Muscle Strength, Draw Length and Archery Technique on Archery Achievement. This research examines four variables consisting of three exogenous variables and one endogenous variable.

The previous research above shows that there is no comprehensive research on the sport of archery, especially those concerning the study of resistance-based archery exercises to get good muscle strength and endurance, thus the novelty of this research is resistance-based archery training.

The researcher chose this title on the grounds that there is a need for innovation and creativity in the archery training process so that the training process is more targeted, interesting, and not boring, so it is considered necessary to create a resistance-based training model for beginner athletes.

METHOD

This type of research is Research and Development, namely the type of research used to produce certain products, and test the effectiveness of these products (Sugiyono, 2015: 297). Research and Development Research aims to produce new products that can be used in training activities to assist coaches in developing training programs and can also optimize athlete performance in achieving the expected goal of achieving the highest achievement. The research was carried out at the DSR Archery Club in Depok City. The research subjects were novice athletes. The instrument used was the 30 M Archery Test in the sport of archery.\

RESULT

Research on the development of resistance-based archery training models for beginner archery athletes as a whole has two general objectives that will be disclosed in the preliminary study, namely 1. Resistance-based training models for strength and endurance training of archery athletes can be developed and adapted to the athlete's age and needs of the athlete. in improving muscle strength for athletes. 2. The importance of strength and muscle endurance training with an effective and efficient training variation model according to the needs and age of the athlete.

The general objectives above then become the basis for researchers conducting preliminary studies using in-depth interviews with coaches in archery clubs and conducting surveys because the general purpose is to make technical preparations by tracing the characteristics of research subjects and the place where the research will be conducted. The analysis stage is carried out to find out how important the training model to be developed is.

Based on the results of the interviews, the conclusions from the needs analysis are: (1) Strength training is not much in demand by athletes, especially those aged 13-15 years, (2) It takes a variety of exercise models that raise the spirit of children in doing, (3) Lack of reference models strength training is easy

to perform, (4) the trainer agrees with the development of the strength training model, and (5) the trainer needs additional references for muscle strength training.

Model Development Planning

After obtaining the data from the needs analysis and findings in the field, the next stage is the model planning stage. The model planning stage is carried out before product testing is carried out. Planning and preparation of a draft model is a stage carried out in order to provide clear guidance in the implementation of research and development. In the first step, the researcher developed a resistance-based archery training model product for beginner athletes, the researcher made a product design consisting of 15 exercise model items.

Model Eligibility

The next stage is conducting an expert test with the aim of getting the feasibility or validity of the model made based on the assessment and advice of the experts. Researchers present three experts in assessing the feasibility of a resistance-based archery training model for novice athletes. The data from the expert tests conducted are summarized in the following table:

Table 2. The data from the expert tests conducted are summarized

Exercise Model	Validation Team			Persentase	
	1	2	3	L	TL
Model 1	L	L	L	100%	0%
Model 2	L	L	L	100%	0%
Model 3	L	L	L	100%	0%
Model 4	L	L	L	100%	0%
Model 5	L	L	L	100%	0%
Model 6	L	L	L	100%	0%
Model 7	L	L	L	100%	0%
Model 8	L	L	L	100%	0%
Model 9	L	L	L	100%	0%
Model 10	L	L	L	100%	0%
Model 11	L	L	L	100%	0%
Model 12	TL	TL	TL	0%	100%
Model 13	L	L	L	100%	0%
Model 14	L	L	L	100%	0%
Model 15	L	L	L	100%	0%
The cumulative results of the validation of the three examiners	Total Number of Practice Items			15 Item	
	Eligible Category Items			14 Item	
	Item Category Not Eligible			1 Item	

Explanation ;

L = Worthy

TL = Not Worthy

Based on the results in table 2, it can be seen that the percentage of expert validation results is 93.3% of the total 15 initial model items, 14 training model items are declared feasible to be implemented and one exercise model is declared inappropriate

on the grounds that if it is carried out it is prone to injury. So that the overall product developed in the category is very feasible.

Small Group Trial Results

The resistance-based archery training model for beginner athletes that has been evaluated by experts, then underwent a phase I revision with the results obtained 14 model items that were feasible to be developed towards the next stage, namely group trials. After the product design was revised, the next step was the model would be tested in a small group trial with 10 research subjects. The following is a summary of the results of small group trials.

Table 3. The following is a summary of the results of small group trials.

Exercise Model	Expert comments and suggestions
Model 1	This model can be applied to train standing parallel (square stance) and to train leg muscle endurance.
Model 2	This model can be applied to train leg muscle strength
Model 3	This model can be applied to train leg muscle strength
Model 4	This model can be applied to train arm and abdominal muscle strength
Model 5	This model can be applied to train arm and abdominal muscle strength
Model 6	This model can be applied to train arm muscle strength
Model 7	This model can be applied to train arm muscle strength and endurance
Model 8	This model can be applied to train arm muscle strength and endurance
Model 9	This model can be applied to train arm and abdominal muscle strength
Model 10	This model can be applied to train arm muscle strength and endurance
Model 11	This model can be applied to train arm muscle strength and endurance
Model 12	This model can be applied to train arm muscle strength
Model 13	The training model is quite good as the final stage of archery practice and the player's feeling when releasing the bow.
Model 14	This model is in accordance with the purpose of the final movement coordination exercise in archery.

Based on the results of the evaluation and small group trials conducted by the researcher, it can be said that 14 model items are feasible to use, and one model item is dropped because it has similarities with the 11 exercise model items, namely model item number 8 (fall).

The next stage will be the trial phase of the revised large group model based on the evaluation of the small group trial. The following conclusions are obtained based on small group trials:

1. A total of 13 models can be applied and used with suggestions for the implementation of exercises adjusted from easy to difficult levels so that children's abilities can increase.

2. Found one model that is less innovative because it has the same form of exercise pattern with the previous model.
3. The preparation of the model according to the experts is stated to have been well structured in accordance with the series of archery movements
4. The firmness of the coach must be paid attention to the athlete so that in the implementation of the child's training, not only to complete the exercise quickly but precisely in accordance with good and correct basic movement techniques.
5. The volume of exercise loading must be adjusted to the abilities of each child.

The results of a small group trial conducted on 14 items of resistance-based archery training models for beginners aged athletes that have been evaluated by experts, based on the results of the overall analysis, 13 models are feasible to continue large group trials.

Large Group Trial Results

The product of the resistance-based archery training model for beginner athletes has been improved based on the results of the evaluation at the small group trial stage, then the large group trial stage continued. Based on the results of small group trials, 13 appropriate models were obtained as well as several refinement of practice items in accordance with the suggestions and input of experts and trainers. At this stage, the researchers used a research subject of 25 beginner athletes at the DSR Archery Club in Depok City in the application of a resistance-based archery training model for beginner athletes as shown in the following table:

Table 4

Model of training	**Comments of expert judment**
Model 1	This model can be applied to train standing parallel (square stance) and to train leg muscle endurance
Model 2	This model can be applied to train leg muscle strength
Model 3	This model can be applied to train leg muscle strength
Model 4	This model can be applied to train arm and abdominal muscle strength
Model 5	This model can be applied to train arm and abdominal muscle strength
Model 6	This model can be applied to train arm muscle strength
Model 7	This model can be applied to train arm muscle strength and endurance.
Model 8	This model can be applied to train the strength of the arm and abdominal muscles.
Model 9	This model can be applied to train arm muscle strength and endurance
Model 10	This model can be applied to train arm muscle strength and endurance
Model 11	This model can be applied to train arm muscle strength
Model 12	The training model is quite good as the final stage of archery practice

	and the player's feeling when releasing the bow.
Model 13	This model is in accordance with the purpose of the final movement coordination exercise in archery.

The results of a large group trial conducted on 13 models of resistance-based archery training for beginner athletes, based on the evaluation results from experts and input from the trainer, all models are feasible to use. The next step after the large group trial and the refinement of the exercise model based on the evaluations found in the field and suggestions from experts, the improved model will be applied to the effectiveness test.

Model Effectiveness Test

The research subject used by researchers to test the effectiveness of the resistance-based archery training model for beginner athletes. A total of 40 athletes participated in the effectiveness test phase of the Depok City DSR Archery Club. Because in this testing stage the researchers needed two groups, namely the experimental group, namely the group that was given treatment with a resistance-based archery training model as many as 20 samples and the second control group, namely the group that carried out strength archery exercises that are usually done in the club as many as 20 samples.

Experimental Group Test Results

Based on the counter using SPSS, the results from the Shapiro-Wilk analysis were obtained. The pre-test significance was 0.613 and the post-test was 0.738, meaning that the probability value or significance value is greater than (0.05), then the data is normally distributed.

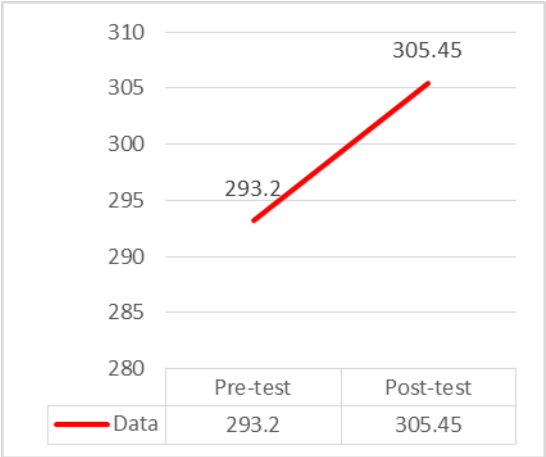
Next, to determine the effect or increase in the results of the exercise before and after being treated with the resistance-based archery training model, two paired averages were tested (paired sample t-test). The results of testing the data are presented in table 5:

Table 5 .The results of testing the data

	Paired Differences		t	df	Sig. (2-tailed)
	Mean	Std. Deviation			
Data Pre Test - Post Test	12,250	3,82340	14,329	19	,000

The paired sample t-test results show the t-count = 14,329 and p-value = 0.00 <0.05, which means that there is a significant effect between before and after being treated with resistance-based archery training models for novice athletes. Based on these results, it can be concluded that the resistance-based archery training model for beginner athletes is effective and can increase the athlete's muscle strength. The exercise model developed has a significant effectiveness.

Figure 1 Experimental Product Effectiveness Test Graph



The graph above illustrates the average score obtained before and after being treated with a resistance-based archery training model for athletes aged 13-15 years with the results showing an increase in the average score from before being treated to after being given treatment.

Control Group Test Results

Based on the counter using SPSS, the results from the Shapiro-Wilk analysis were obtained. The significance of the pre-test was 0.327 and the post-test was 0.695, meaning that the probability value or significance value is greater than (0.05), then the data is normally distributed.

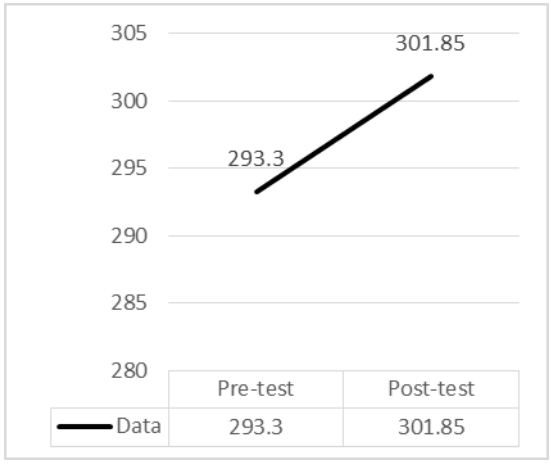
Next, to find out the effect or increase in the results of the exercise before and after doing the strength archery exercises that are usually done at the club, a paired average test was carried out (paired sample t-test). The results of testing the data are presented in table 6:

Table 6

	Paired Differences		t	df	Sig. (2-tailed)
	Mean	Std. Deviation			
Data Pre Test - Post Test	8,550	2,79991	13,656	19	,000

The results of the paired sample t-test show that tcount = 13.656 and p-value = 0.00 <0.05, which means that there is a significant effect between before and after doing strength archery exercises that are usually done in the club for athletes aged 13-15 year.

Figure 2 Graph of the Model in the Control Group



The graph above illustrates the average score obtained before and after doing strength archery exercises which are usually done at the club for athletes aged 13-15 years with the results showing an increase in the average score from before being treated to after being given treatment.

Comparison Results Between Experiment And Control Group

The significance test of the difference in improvement between the experimental group and the control group used the Independent Sample t Test. The following are the results of testing the data presented in table 7:

Table 7

	Levene's Test for Equality of Variances		t	df	Sig. (2-tailed)	Mean Difference
	F	Sig.				
Gain Data Pada Kedua Kelompok	3,108	,086	3,492	38	,001	3,70000

Based on the results of the difference test, it can be concluded that tcount = 3,492 with Sig. (2-tailed) = 0.001 <0.05, it can be concluded that there is a significant difference between the experimental and control groups. Based on the average value difference in the experimental group with a score of 12.25 and in the control group with a score of 8.55. So it can be concluded that the treatment given to the experimental group, namely the resistance-based archery training model, has higher effectiveness and can increase muscle strength for athletes aged 13-15 years.

DISCUSSION

Product Improvement

Based on the data above, it can be concluded that the resistance-based archery training model for athletes aged 13-15 years is feasible to use and effective in increasing muscle strength. The product produced by the researcher, namely the resistance-based archery training model for athletes aged 13-15 years, has several shortcomings that the researcher will describe to achieve the perfection of this product. Then the input in question is as follows:

1. The training model should explain the implementation mechanism in detail and use language that the trainer can easily understand when implementing the implementation in the field.
2. The duration of the implementation of the exercise model should be considered in more detail so that the time used is appropriate and efficient.
3. Training equipment is made even more attractive so that athletes are more motivated in doing exercises.

Product Discussion

The resistance-based archery training model for athletes aged 13-15 years is made to be a reference or reference for archery training, especially with different variations to help coaches in the field. This training model was developed based on the needs analysis in the field. Products that have been

evaluated with several existing weaknesses and product revisions are made to become a good final product, it can be conveyed some of the advantages of this product are as follows:

1. The product provides a variety of resistance-based archery training models.
2. The product provides varied, innovative, and motivating exercises for children to carry out training activities.
3. This exercise model is useful for increasing strength and improving archery movement patterns from start to finish.
4. Provide trainer references as training materials in the field to support the needs of training materials.

Product Limitations

This research was made with the best in order to get perfect results in accordance with the limits of the researcher's abilities, but in every ability, a researcher must have limitations. It must be admitted that in this study there are many shortcomings, therefore the researcher will put forward these limitations as follows:

1. This research can be carried out on a wider scope than the researcher did.
2. The limitation of the researcher's ability to describe the implementation of each model item made model
3. The media used in the exercise model are many more that can be used.

CONCLUSION

Research that produces resistance-based archery training models for beginner athletes. Based on research data consisting of needs analysis, product design, expert validation, small group and large group trials, and effectiveness tests so that a discussion of the research results can be obtained, the researchers can draw the conclusion that:

1. Resistance-based archery training models for beginner athletes can be developed and applied in training archery skills and muscle strength training.
2. The training model developed based on research data obtained effective results for beginner athletes.

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