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Circuit bodyweight training: does it affect increasing arm muscle endurance and archery accuracy in pandemic conditions?

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Abstract: Restrictions on community activities due to the spread of the Covid-19 virus have changed sports in Indonesia, forcing athletes to practice independently in their respective homes with training programs created by coaches. This study aims to find out the effect of circuit body weight training on arm muscle endurance and archery accuracy of archery athletes. This research is an experimental method of one group pretest-posttest design. This study employed purposive sampling with the criteria of elite archery athletes, still in high school, male, and willing to participate. Total of 12 athletes was given treatment with 8 movements for 16 meetings. The instrument is a holding bow digit test for arm muscle endurance, while archery accuracy uses 50 meters of archery. The collected data were examined for normality and homogeneity, then followed with t-test with the result that t count = 0.00 less than t (0.05). Based on the results, it is concluded that circuit bodyweight training positively improves arm muscle endurance and accuracy of archery athletes. Therefore, giving circuit bodyweight training can be used as a recommendation for physical exercise to increase arm muscle endurance and archery accuracy in archery athletes.

Keywords: body weight, circuit training, muscle endurance, archery accuracy.

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INTRODUCTION

The Covid-19 pandemic, apart from slowing down the economic structure, also hampered athletes' preparation for the National Sports Week (PON) XX 2020 Papua (Susanto, 2020). In addition to the XX PON sports agenda which experienced obstacles, the ASEAN Para Games in the Philippines have also been canceled as well as several other sports agendas due to the Covid-19 pandemic (WHO, 2020). The intensity of training began to decrease and athletes felt bored because they had to stay at home. Expected to improve physical condition and stable performance they must keep practicing for performance and matches.

Archery is a sport that is liked and favored by people from all walks of life, from the lower social economic status to the higher, children, teenagers, adults, and the elderly (Jannah, 2017). This sport is a target sport with a count on points, the highest point is 10 and the lowest is 5, if the arrow deviates from the target, it gets 0 points (Ogasawara et al., 2021). Thus, archery here can be concluded as a sport that is favored by various groups and some people really focus on this sport in the hope that they can excel. Archery achievement can be measured from training or competition because archery is a measurable sport and the role of physical condition is very dominant. Many physical factors affect this condition, one of which is arm muscle endurance (Yuliato et al., 2015). According to previous research showed that the dominant component in archery is muscle endurance which includes arm muscles, shoulders, and archery accuracy (Ashadi, 2018; Asaribab & Siswantoyo, 2015). The term endurance in the world of sports is known as the ability of an athlete's organs to fight fatigue during activities or work. Endurance is the ability to do work over a long period of time (Obrusnikova et al., 2021). According to endurance, the body's ability to carry out sports activities for a long time without experiencing significant fatigue (Franssen et al., 2005). Muscular endurance can be defined by the ability to repeatedly produce

voluntary force or to maintain voluntary force production by a specific muscle or muscle group at a submaximal level for long periods of time (Khalafi et al., 2021). From the opinions of the experts above, it can be concluded that. Endurance is the ability of a person to carry out movements with his whole body for a long time and at a moderate to fast tempo without experiencing severe pain and fatigue, therefore to increase the accuracy of archery for power component was very necessary in the sport of archery for the stability of releasing arrows to the point where they are right on target.

Archery accuracy is one of the physical components that must be owned by an archery athlete. according (Nawir, 2011; Saing et al., 2022) Archery accuracy is a goal where this condition if the athlete does not have high accuracy, it is certain that the athlete gets defeated. Archery accuracy in archery is the most important point when archery athletes because it is associated with good/stable technical quality and maximum results, it can be categorized as low accuracy if from 10 points only 7-5 points are used by using an archery instrument at a distance of 50 meters (Mahesh, 2021). Based on research (Aryana, 2013; O'Connor et al., 2020) athletes can be on target until they get the maximum point or X is the main achievement. This means that to support all activities and be able to provide maximum results, muscles must be trained to achieve certain qualities that suit their needs to improve archery accuracy.

Biomechanically, the accuracy distance of 50 meters is produced by actions and reactions from releasing arrows to throwing parabolic shape so that a straight line from a standing position and the target position is aligned (Latella & Haff, 2020). In line with another research, the resulting movements are the result of activation of the motor units in the mind, filing, accuracy and muscles (Bell et al., 2020). It can also be said as the ability to do steadiness/stabilization in order to generatse monotonous results (Green et al., 2018). Based on some of the opinions above, archery accuracy is the essence of releasing arrows which is used to provide maximum accuracy results from the movement of releasing arrows so that the score obtained is high with an average score of 358-347.

Reports from Banyumas Regency, showed that archery athletes in Banyumas Regency had never practiced due to the COVID-19 pandemic, there were still athletes who thought that if they didn't shoot archery, they didn't practice even though physical exercise could be done anywhere. Lack of understanding of the variations in the physical conditions specific to archery, there are some athletes who are lazy when participating in independent training, then there are still athletes who when archery clearly visible tremors in their left hand. The vibration experienced will have an impact on arrow groping which causes a lack of archery accuracy. Some coaches assume that the physical condition training for archery is only in the field by shooting as many arrows as possible. Based on scoring data every month in 2020 which is carried out online, the score is obtained in the less category with a total score of 733-750 while the data on arm muscle endurance using the hanging lift test from the Indonesian Physical Fitness Test shows an average of 8, 3, if the results are converted into norms, they are categorized as less. In detail, from the data of 20 athletes, 10% were in the good category, 35% in the moderate category, 45% in the poor category, and 10% in the very poor category. These results can be interpreted that the archery accuracy and arm muscle endurance of archery athletes in Banyumas Regency are in the poor category, so an appropriate training method is needed to improve archery accuracy and arm muscle endurance of archery athletes during the COVID-19 pandemic.

Basically, bodyweight training similar as weight training but is distinguished by different exercise models and variations of exercise, body weight training is a type of weight training that can be done without using tools, and as a burden using your own body weight such as pull ups, push ups, chair dips, crunches, and planks. Body weight training is an exercise with natural movements and allows you to move freely through the exercises in it. This exercise will train the strength of various parts of the muscles without using tools (Lestari & Nasrulloh, 2018; Nasrulloh et al., 2021). It can be concluded that this exercise is an exercise in which the burden is on the body itself without using external weights so that it does not require the assistance/interference of the trainer to help lift the load or a large place to practice, as for the various exercises, namely: 1) Reguler Push-Up; 2) Diamond push-up; 3) Wide push-up; 4) Pike push-up; 5) Pseudo push-up; 6) Archer push-up; 7) Hindu push-up; 8) Bent Knees push-up.

Circuit or better known as circuit training, one of the most common exercise systems used to burn fat. This circuit training is a method that usually consists of several items or types of exercises that must be done within a certain time, after completing one exercise item, immediately transfer to another item without any recovery time or intervals and so on until the exercise item is completed, it is said to complete one circuit (Arjuna, 2020; Campo et al., 2021; Muhammad & Nasrullah, 2016; Prakoso & Sugiyanto, 2017). From research stated that this circuit training method can increase the endurance arm

muscles so that when holding position athlete does not feel tremors which causes the accuracy to increase (Akinci et al., 2020). It can be concluded that circuit body weigh training is a form of exercise to improve physical condition with one's own body weight. Of course, this exercise can be done independently by practicing an exercise program independently.

Because there has been no research on the effect of circuit body weight exercise on archery athletes, the problem can be formulated as to whether there effect of circuit bodyweight training increasing arm muscle endurance and archery accuracy in archery athletes in Banyumas Regency. Studies demonstrate that body weight exercises can increase arm muscle endurance and arm muscle strength when rowing, archery, and steady when holding a rifle in shooting sports (Li et al., 2021). Therefore, components of good accuracy are not only archery training, but also arm muscle endurance for maximum archery stability. This circuit body weight can be an alternative exercise program apart regular archery training in the field, this circuit bodyweight exercise can also be done at home independently and there fore athletes have no reason to rest and relax during the COVID-19 pandemic.

METHODS

The research embraced an experimental approach and to obtain the desired data in this study used a technical test. The subjects of this study consisted of 12 athletes selected purposively, with the criteria of elite archery athletes, still in high school, male and willing to be research material. This research instrument uses a holding bow digit test for arm muscle endurance with a validity test of 0.961 (Prasetyo & Siswantoyo, 2018), while for archery accuracy by shooting at a distance of 50 meters for archery accuracy (Yachsie et al., 2021). Exercises were given 18 times, including pretest & posttest. The circuit body weight training exercises are: 1) Regular Push-Up; 2) Diamond push-up; 3) Wide push-up; 4) Pike push-up; 5) Pseudo-push-up; 6) Archer push-up; 7) Hindu push-up; 8) Bent Knees push-up. Determination of the load using the maximum heart rate by means of 220 – age, then the intensity is 50-70% with 30 seconds of recovery, 8-10 repetitions, 3-4 times sets and 3 minutes rest between sets. The data displayed in this study are in the form of average values and standard deviations. This study analyzed the relationship between independent practice using paired T-test analysis. Statistical analysis using SPSS version 20 application with a significance level ($p>0.05$).

RESULTS AND DISCUSSION

In the research that has been carried out in the form of pretest and posttest data on arm muscle endurance and archery accuracy (See Table 1).

Table 1. Descriptive Statistics of Pre-test and Post-Test

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest Arm muscle endurance	12	11.00	14.00	12,33	0.88
Archery Accuracy Pretest	12	123.00	267.00	2.19	37.98
Posttest Arm muscle endurance	12	12.00	16.00	14.08	1.16
Archery Accuracy Posttest	12	200.00	307.00	2.84	29.01

Based on Table 1, the pretest value of arm muscle endurance training is a minimum of 11.00, a maximum of 14.00, a mean of 12.33, and a standard deviation of 0.88. The pretest value of archery accuracy is a minimum of 123, a maximum of 267, a mean of 2.197, and a standard deviation of 37.98. It means from the data there is an increase from pretest to posttest.

Table 2. Normality Test Result

Data		p	Sig.	Description
Arm muscle endurance	Pretest	0,086	0.05	Normal
	Posttest	0.373	0.05	Normal
Archery accuracy	Pretest	0.883	0.05	Normal
	Posttest	0.071	0.05	Normal

Normality test caried out by the Kolmogorov Smirnov technique, the results obtained are the sig pretest value of arm muscle endurance of 0.086 > 0.05 and archery accuracy of 0.883 > 0.05, while for

the posttest arm muscle endurance of 0.373 > 0.05 and accuracy archery, 0.071 > 0.05 It can be concluded that all data are normally distributed.

Table 3. Levene Test Wilk Homogeneity Test Result

Data	Sig.	Description
Pretest Arm muscle endurance	0.061	Homogen
Archery Accuracy Posttest	0.056	Homogen

Based on Table 3, the calculation results obtained a significance value of Pretest-Posttest of Muscle Endurance of 0.061 while the Pretest-Posttest of archery Accuracy was 0.056. It means that the data group has a homogeneous variant. Thus the population has the same variance or homogeneity.

Table 4. Paired t-test

Pretest – posttest	df	T table	T count	P	Sig.
Arm Muscle Endurance	11	1.80	34.019	0.000	0.05
Archery accuracy	11	1.80	41.894	0.000	0.05

Based on Table 4, it is obtained the value of t-count (41.894) higher than t table (1.80) and p value is less than 0.05. This means that there is an effect of body weight training on arm muscle endurance in archery athletes in Banyumas Regency. Based on Table 4, the t-count value (34.019) is higher than t table (1.80) and p-value is less 0.05. It can be interpreted that there is an effect of body weight training on the arm muscle strength of archery athletes in Banyumas Regency. Based on the results of the two t-tests, it shows that if the value of t count is higher than t table, with the results showing the hypothesis is accepted.

This study showed an increase in arm muscle endurance and archery accuracy, by giving circuit body weight training exercises. The results obtained when maintaining the holding position the athlete was still standing straight then when pulling the bow, the athlete felt comfortable marked by the bowstring/string touching the lips and the pull finger touches the chin, therefore endurance and accuracy of this archery can be increased by circuit bodyweight training exercises. Based on several previous research, weight training is an exercise that uses a form of movement that is summarized in several posts and sequenced according to the goals and rules set. Thus, this research on circuit weight training can increase the ability of muscle endurance (Cao et al., 2021; Mahesh, 2021; Nasrulloh, 2013; Obrusnikova et al., 2021; Oliveira & Silva, 2016; Pettersson et al., 2019; Tanaka et al., 2020; Yachsie, 2019; Yoshimura et al., 2021). Significant increase in muscle endurance after being given the circuit weight training exercise treatment, namely an increase in upper body muscle endurance, abdominal muscle endurance and arm and shoulder muscle endurance. Weight training significantly increases the endurance of archery athletes (Nasrulloh et al., 2022). Based on research (Coratella & Schena, 2016; Decheline et al., 2020; Nyberg et al., 2016; Rohmansyah et al., 2020; Wijaya et al., 2020) the ability of a muscle or a group of muscles to exert external force repeatedly over a long period describes muscle endurance which means the athlete was fit. Therefore, muscle fitness plays an essential role in the long-term development stage of athletes/in the duration of the match which is quite time-consuming. From some of the opinions above, it can be concluded that muscle endurance is a group of muscles capacity to create contractions repeatedly for a certain period of time against a load. The part of the shoulder that usually makes the shoulder rise up.

The circuit bodyweight training program in this study showed that the exercise movements from the first post to the last post, and were arranged in a circle in a predetermined place/at their respective homes, after the time ran out, the researcher gave a sign to stop and the athlete walked in place while walking. move to the next post. Furthermore, the 8-post movement is called a circuit, then after the athlete has done one circuit, they are given a break of about 3 minutes (Fahrizqi et al., 2021). Good exercise program causes the score to increase, this can be obtained when the physical condition is supportive or is in shape and balanced with programmed exercises (Serrien et al., 2018). In line with providing structured and consistent training can increase accuracy especially in target sports (Pratiwi & Mansur, 2018). It was concluded that the provision of circuit body weight training is an alternative that

can be given post the Covid-19 pandemic in order to increase stability in certain branches that require high accuracy.

From the results of the study, the accuracy of archery increased very high because with strong muscle endurance the tremor was reduced during the process of holding the bow so that when releasing the arrow the hit was on target so that it got good points, namely at points X, 10, 9, and 8. Previous research (Lu et al., 2021) supports that archery requires consistency when releasing arrows. Archery accuracy is an activity using bow and arrow, to aim an object so that it sticks to the targeted point (Ogasawara et al., 2021). In archery, arm muscle endurance and strength are components that an athlete must possess in order to get a good target when shooting (Aryani, 2017). This means that the muscles that are subjected to the training load alternate with each exercise (Prasetyo, 2016). When performing an archery move, a player must draw his bow to the maximum to produce a fast arrow shot (Yachsie, 2021). Based on the results of the research above, there is an increase in archery accuracy because the condition of strong shoulders and good endurance causes athletes to feel less tired when archery, then when pulling a bow the athlete feels lighter so that the accuracy increases. Based on monthly observations and scoring conducted once a month in Banyumas Regency, the accuracy of this archery increased by looking at the average score that could be within 50 meters of 312-322.

Muscle strength treatment/exercise also increased marked by a significant increase in the hand when gripping. Due to being trained regularly here, not only his endurance but also his strength has increased. Based on research (Bompa & Buzzichelli, 2019; Mair et al., 2019; Oranchuk et al., 2019; Rawe et al., 2017). Physiologically, muscle strength is directly proportional to the volume/size of the muscle, the greater the muscle volume, the stronger the contraction produced to perform a movement. One study states that strength is the force of muscle contraction achieved in one maximum effort (Cronin et al., 2017). It can be concluded that muscle strength is the ability of the muscles to be able to overcome resistance or load in carrying out activities such as holding or moving loads. Someone who has good muscle strength can do and carry out heavy work for a long time. People who are physically fresh will have strong muscles and are able to work efficiently, and people who are physically fit will have strong muscles and are able to work efficiently because in this sport the athlete will not mind pulling the bow in many repetitions. Arm endurance was obtained to hold the arrow before releasing the arrow to hit the target, while arm muscle strength is used when pulling the bow to a holding position and archery accuracy is the goal of releasing arrows. With the provision of circuit bodyweight training, it is expected to become a recommendation for athlete performance maintainance post the Covid-19 pandemic because of training ease and flexibility factors.

CONCLUSIONS

Based on the result of this research, it can be concluded that circuit bodyweight training positively improves arm muscle endurance and accuracy of archery athletes. Giving circuit body weight training can be recommended for physical exercise to increase arm muscle endurance and accuracy in archery athletes. This exercise can be used as a review material to improve archery performance.

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