

The Effect of Resistance Band Training on Upper Limb Muscle Endurance, Abdominal Muscle Endurance, Back Muscle Endurance and Archery Accuracy in Athletes at the Surabaya Fast Archery Club

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ABSTRACT

Archery is a sport that requires high concentration, postural stability, coordination, and good physical condition for a long time. The physical components needed by archery athletes are muscle endurance, especially in arm muscle endurance, abdominal muscle endurance (core), and back muscle endurance. Physical training using resistance bands and planks is believed to be an effective solution to increase muscle endurance capacity which is useful for supporting the stability and accuracy of athletes' archery. The method used in this study is a quasi-experimental method with a quantitative approach and a Two Group Pretest-Posttest Design. The sample in this study amounted to 20 athletes from the Surabaya Fast Archery Club and the sample was divided into two groups randomly and a pretest-posttest was carried out on measurement test items in the form of push-ups, sit-ups, back-ups, and scores at a distance of 40 meters which was carried out to develop an appropriate training program. The following results of the t-test are 0.00 or $P < 0.05$ and the results of the independent t-test are > 0.05 or $P > 0.05$, so there is an effect of resistance bands on muscle endurance. Research has shown that resistance band exercises and planks are effective in improving muscle endurance in the arms, abdomen and back. There was no significant difference between the seated face pull and rowing programmes and the plank. This improvement in muscle endurance was also not associated with archery accuracy.

Keywords: Resistance Bands; Arm Muscle Endurance; Abdominal Muscle Endurance; Back Muscle Endurance; Archery

Authors' Contribution: a – Study Design; b – Data Collection; c – Statistical Analysis; d – Manuscript Preparation; e – Funds Collection

INTRODUCTION

Sport is an activity related to our physical (bodily) well-being. In Indonesian, the term “olahraga” derives from the word “olah”, meaning “to be able to do something”, and “raga”, which can be interpreted as the physical form and the body as a whole (Prayoga, 2023). Sport itself plays an important role in our bodies and our daily lives, as engaging in sporting activities helps the body to appear fitter and protects against serious or life-threatening illnesses.

Archery is a sport that requires a high level of coordination; in this sport, equipment and settings are determined and adjusted on an individual basis, and shooting accuracy is heavily influenced by technical execution (Iv. Ivanov, 2025). Archery also requires good archery technique, as well as synchronisation, endurance, flexibility, draw length and stability (Munawar, 2014). If an athlete lacks good muscular endurance, the consequence of this is inconsistent arrow impact; however, when an athlete develops good muscular endurance through a prescribed series of exercises, their archery accuracy is also expected to improve (Billy Yachsie et al., 2022). The ability to aim and release the arrow is one of the most

important factors in success in archery (Faqiha & Pratama, n.d.). Movement during each phase of the archery shot is crucial for shot accuracy, maintaining the shot and improving archery stability (Iv. Ivanov, 2025).

According to Ramadhan, Sari, Rachman, et al. 2023, resistance bands are devices used to support exercise; they are made of rubber and are used to add resistance to exercise movements or core physical training. The resistance levels of these bands are indicated by colour, with each colour corresponding to a specific weight range: Green (X-Light): 3–5 lb (1.5–2.5 kg), Blue (Light): 10–12 lb (5–6 kg), Yellow (Medium): 15–20 lb (7–9 kg), Red (Heavy): 25–30 lb (11.5–14 kg), Black (X-Heavy): 35–40 lb (15.75–17 kg). Generally, resistance bands come in a variety of colours to indicate the resistance level of each band. However, not every resistance band has a colour code (Reza Fatchutahman, 2023). Resistance bands are exercise equipment made of rubber, and there are several exercises that can be performed using them, such as the seated face pull and seated rowing. The seated face pull is an exercise designed to work the triceps and back muscles, whilst the seated rowing exercise is designed to work the triceps, deltoids and trapezius muscles.

METHODS

This study employed a quantitative research design, specifically a quasi-experimental design, using a two-group pre-test–post-test control group approach. Grouping in this study utilised random sampling, with a sample size of 20 female athletes aged 15–20 years who were active in a club. The intervention lasted for 6 weeks, comprising a total of 18 sessions; Group 1 received the seated face pull and plank exercises, whilst Group 2 received the seated rowing and plank exercises.

Data collection involved pre-test, treatment and post-test assessments. The test instruments used in this study comprised a 1 minute push-up test, a 1 minute sit-up test, a 1 minute back-up test, and a 40 meter archery test, in which each athlete shot 6 arrows within 3 minutes, for a total of 72 arrows.

Data analysis in this study utilised descriptive statistics to determine the mean and standard deviation. A normality test (Shapiro-Wilk) was conducted to ascertain whether the data in each group in the study followed a normal distribution. A homogeneity test (Levene's test) was carried out to determine whether all data were homogeneous or equivalent. A paired-sample t-test was used to determine whether there was an effect following the application of the treatment. An independent samples t-test was used to determine the differences in treatment between the seated face pull and plank exercises and the seated rowing and plank exercises. Furthermore, Pearson's bivariate correlation test was used to determine the relationship between improvements in muscular endurance and improvements in archery accuracy. Data analysis was carried out using SPSS 26 software with a significance level of 0.05.

RESULTS

The descriptive results show that there was a difference in the mean pre-test–post-test scores between Group 1 (seated face pull and plank) and Group 2 (seated rowing and plank) for the push-up, sit-up, back-up and scoring test items. The descriptive results are presented in Table 1.

Table 1. Pre-post Results

Data	Group 1	Group 2
Push-Up	28,1	25,8
Sit-Up	31,25	28,05
Back-Up	60,7	60,95
Scoring	515,2	523,3

The average scores for Group 1 show that the scores for push-up and sit-up were higher than those for Group 2 conversely, the average scores for the back-up test items and the group scores were higher for Group 2 than for Group 1.

Table 2. Normality Test Results

Shapiro-Wilks			
Variable	N	Sig.	Note
Pretest Push-up kelompok 1	10	0,215	P > 0,05
Pretest Push-up kelompok 2	10	0,485	P > 0,05
Posttest Push-up kelompok 1	10	0,405	P > 0,05
Posttest Push-up kelompok 2	10	0,294	P > 0,05
Pretest Sit-up kelompok 1	10	0,530	P > 0,05
Pretest Sit-up kelompok 2	10	0,095	P > 0,05
Posttest Sit-up kelompok 1	10	0,201	P > 0,05
Posttest Sit-up kelompok 2	10	0,251	P > 0,05
Pretest Back-up kelompok 1	10	0,963	P > 0,05
Pretest Back-up kelompok 2	10	0,919	P > 0,05
Posttest Back-up kelompok 1	10	0,152	P > 0,05
Posttest Back-up kelompok 2	10	0,599	P > 0,05
Pretest Skor kelompok 1	10	0,170	P > 0,05
Pretest Skor kelompok 2	10	0,092	P > 0,05
Posttest Skor kelompok 1	10	0,146	P > 0,05
Posttest Skor kelompok 2	10	0,187	P > 0,05

The normality test showed that both groups followed a normal distribution. The significance values for Group 1 push-up results were $0.215 > 0.05$ for the pre-test and $0.405 > 0.05$ for the post-test, whilst for Group 2 they were 0.485 for the pre-test and 0.294 for the post-test. As for the sit-up results, Group 1's pre-test value was $0.530 > 0.05$ and post-test $0.201 > 0.05$, whilst for Group 2, the pre-test value was $0.095 > 0.05$ and the post-test 0.251 . As for the 'Backup' results, the pre-test score was $0.963 > 0.05$ and the post-test score was $0.152 > 0.05$, whilst for Group 2, the pre-test score was $0.919 > 0.05$ and the post-test score was $0.599 > 0.05$. As for the 'Score' results, for Group 1 the pre-test was 0.170 and the post-test was $0.146 > 0.05$, whilst for Group 2 the pre-test was $0.092 > 0.05$ and the post-test was $0.187 > 0.05$.

Table 3. Homogeneity Test Results

Test of homogeneity of variance		
Test	Sig	Note
Pretest Pushup	0,749	P > 0,05
Pretest Situp	0,795	P > 0,05

Pretest Backup	0,985	$P > 0,05$
Pretest Score	0,665	$P > 0,05$

The homogeneity test between the pre-test and post-test showed that the data collected by the researcher had a p-value > 0.05 , with the pre-test push-up result at $0.749 > 0.05$, the pre-test sit-up result at $0.795 > 0.05$, the pre-test back-up result at $0.985 > 0.05$ and the pre-test score at $0.665 > 0.05$. It can therefore be concluded that the data possessed by the researcher is homogeneous. As these values are greater than 0.05, the data meets the criteria for analysis using paired and independent t-tests.

Table 4. Results of Paired Sample t-test

Paired T-Test		
Variable	Sig. (2-tailed)	Note
Push up	0,00	$P < 0,05$
Sit up	0,00	$P < 0,05$
Back up	0,00	$P < 0,05$
Skor	0,00	$P < 0,05$

Based on the results of the paired t-test, a significance value of $0.00 < 0.05$ was obtained. These results indicate that the seated face pull exercise method has an effect on back muscle endurance, that the seated rowing exercise method has an effect on arm muscle endurance, and that the plank exercise method has an effect on abdominal endurance.

Table 5. Results of Independent t-test

Independet t-test		
Variable	Sig. (2-tailed)	Note
Push up	0,626	$P > 0,05$
Sit up	0,319	$P > 0,05$
Back up	0,560	$P > 0,05$
Skor	0,666	$P > 0,05$

Based on the results of the independent t-test, the significance values obtained for upper-body muscle endurance (push-ups) were 0.626, abdominal muscle endurance (sit-ups) 0.319, back muscle endurance (back-ups) 0.560, and archery scores 0.666. As all the Sig. (2-tailed) results were all greater than 0.05 ($p > 0.05$), this proves that no significant difference in effect was found between the seated face pull, the seated rowing and the plank. These exercise programmes are equally effective in improving both muscle endurance and the athletes' archery scores.

Bivariate Correlations				
Kelompok	Variable	Sig	Ket.	pearson correlation
Kelompok 1 Seated face pull + plank	push up kelompok 1	0,629	$P > 0,05$	0,175
	sit up kelompok 1	0,432	$P > 0,05$	-0.128
	back up kelompok 1	0,416	$P > 0,05$	0,290

Kelompok 2 seated rowing +	push up kelompok 2	0,945	P > 0,05	-0.025
	sit up kelompok 2	0,327	P > 0,05	0,346
	back up kelompok 2	0,362	P > 0,05	-0.323

Based on the results of the bivariate correlation test, a p-value of > 0.05 was obtained. These results indicate that there is no correlation between improvements in upper-body muscle endurance, abdominal muscle endurance and back muscle endurance and improvements in archery accuracy.

DISCUSSION

The results of the study show that Group 1 (seated face pull and plank) achieved the same high scores as Group 2 (seated rowing and plank). These findings indicate that training programmes comprising seated face pulls and planks, and those comprising seated rowing and planks, are equally effective at improving upper-body muscular endurance, core muscular endurance, back muscular endurance, and archery accuracy.

One of the most important components of an athlete's training programme to improve performance is physical condition. Archery is a physical activity that requires muscular endurance and strength, so archers must focus on and maintain their muscular endurance for as long as possible. The results above show an improvement in upper arm muscular endurance, as measured by the push-up test, following a 6-week training programme involving seated face pulls and seated rowing using resistance bands. In a previous study conducted by Firman Adinata Pratama (2020), tests were carried out on a resistance band group using the biceps curl method, a group using dumbbells, and a control group over a 6-week period. The results showed that in all three groups, arm muscle endurance improved with the resistance band training method in the sport of fencing (Adinata Pratama, 2020).

The findings of this study suggest that training with resistance bands can be used as a training model for archery athletes. This conclusion is drawn because training with resistance bands offers several advantages, such as their elasticity and thickness, which provide different levels of resistance and can therefore be adjusted; furthermore, training with resistance bands can be carried out at home or at a training venue (Prasetyo et al., 2020). In the studies reviewed, it was found that, in addition to improving strength and balance, training with resistance bands helps to prevent pain and permanent damage (Kang et al., n.d.). According to (Park et al., 2016), to shoot an arrow accurately at a target, an archer needs to control the precise distribution of force and maintain a balanced posture, right down to changes in breathing; any imbalance in these factors can directly affect performance in archery.

According to Tudor O. Bompa and Michael Carrera (2015), muscle endurance training must be tailored to the physiological and anatomical criteria of each specific sport. As archery requires a simultaneous combination of flexion and extension movements in both arms to draw and hold the bow, the exercises provided can improve the muscular endurance of the arms, abdominal muscles and back muscles; these include the resistance band seated face pull and seated rowing.

Based on the above explanation, it can be concluded that training with resistance bands has an effect on arm muscle endurance, abdominal muscle endurance, back muscle endurance and archery accuracy in the sport of archery.

CONCLUSION

Based on the analysed research findings, the training programme comprising seated face pulls and seated rowing with a plank significantly and demonstrably improved the athletes' upper-body muscular endurance and archery performance scores from the pre-treatment (pre-test) to the post-treatment (post-test) stages (Sig. < 0.05).

Furthermore, the training programme comprising seated face pulls and seated rowing with a plank significantly and demonstrably improved abdominal muscle endurance and the athletes' archery performance scores from the pre-treatment condition (pre-test) to the post-treatment condition (post-test) (Sig. < 0.05). The seated face pull and seated rowing with plank training programme significantly and effectively improved the athletes' back muscle endurance and archery performance scores from the pre-treatment condition (pre-test) to the post-treatment condition (post-test) (Sig. < 0.05). No significant difference in effect was found between the seated face pull combined with the plank and the seated rowing combined with the plank (Sig. > 0.05).

Both exercises demonstrated equivalent effectiveness, as they were supported by the plank exercise, which was equally effective in building the athletes' core strength. There was no significant positive correlation between the magnitude of the increase in muscle endurance and the improvement in the athletes' archery scores (Sig. > 0.05).

This indicates that changes in athletes' archery scores are more strongly influenced by factors other than the muscle endurance components studied. Coaches are advised to incorporate resistance band training into their programmes to improve arm, abdominal and back muscle endurance, and this approach may also be useful for future research investigating muscle endurance and archery accuracy.

As for the sample criteria for future research, it is recommended that participants have been members of the Fast Archery Club for at least one year; the programme should be implemented for a period longer than six weeks up to eight weeks to achieve optimal results; a control group should be included; and participants should be grouped using ordinal pairing to ensure that each group is of equal size.

AUTHOR CONTRIBUTIONS

All authors contributed to the topic selection and drafting of the article.

DECLARATION

This manuscript was prepared without the aid of artificial intelligence. A professional translator was hired to do the translation, and the Biblioshiny application was used to assist with the data analysis. The authors agree and take full responsibility for the accuracy, integrity, and drafting of the manuscript.

TRANSPARENCY STATEMENT

Research data is available to the relevant author upon reasonable request.

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CONFLICT OF INTEREST

Related to this article publication, there were no interest conflicts.

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ETHICAL CONSIDERATIONS

There was no ethical approval required in this study due to its use of bibliometric data. To improve its validity, three independent professional specialists participated in data collection and screening.

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