



Comparison of Handgrip and Upper Body Strength between Sedentary Individuals and Archers

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Abstract

Study purpose: Muscular strength is crucial for performing daily tasks and enhancing sports performance. However, limited research has compared the handgrip and upper body strength between sedentary individuals and archers. This study aimed to compare the handgrip and upper body strength between the sedentary individuals and archers.

Materials and methods: A cross-sectional study design was employed, involving youth archers of Kelantan Sports Council (n=20; Mean age: 14.7±1.22 years old) and sedentary individuals from Kelantan secondary school (n=20; Mean age: 14.8±1.15 years old). Participants were selected using purposive sampling. Participants' handgrip strength of dominant and non-dominant arms was measured using a hand dynamometer, while the upper body strength was measured via medicine ball throw test. All the tests were conducted for 3 trials; the average of the trials was used the analysis using Mann-Whitney test.

Results: There was a significant difference ($p < 0.05$) in the comparison of handgrip strength for both arms between the groups. Archers exhibited higher dominant handgrip strength (32.5±4.1 kg) than sedentary individuals (25.8±3.9 kg). Similarly, upper body strength demonstrated a significant difference ($p < 0.05$), with archers achieving a longer medicine ball throw distance (5.4±0.6 m) than sedentary individuals (4.1±0.5 m).

Conclusions: To conclude, archers possess greater handgrip and upper body strength than sedentary individuals, highlighting the positive impact of archery training on muscular strength development.

Keywords: Archers, Handgrip, Sedentary individuals, Strength, Upper body.

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Introduction

Muscle strength is essential for maintaining physical function, vitality, and mobility throughout life that enables individual to perform everyday tasks (McLeod et al., 2016; Ramari et al., 2020; Suchomel et al., 2018) such as carrying objects, sweeping the floor, and climbing stairs. Mechanically, muscle strength is defined as the ability of a group of muscles to generate maximum force against resistance (Fragala et al., 2019), either in a pulling or pushing direction (Nasrulloh et al., 2021). Various factors contribute to variances in muscle strength across populations, including age, gender, anthropometric measurements, and lifestyle (Mattioli et al., 2015; Viecegli & Ewald, 2022). A sedentary lifestyle, characterised by low physical activity levels, can lead to muscle atrophy and reduced functional performance, affecting both health and quality of life (Bowden Davies et al., 2019).

In sports, muscle strength is particularly crucial as it enhances performance, prevents injuries, and improves overall endurance. Upper body strength, especially in the arms, shoulders, and back is vital in sports that require repetitive movement patterns, such as archery (Sezer, 2017). Archers rely heavily on their upper body muscles to maintain posture, draw the bowstring, and stabilize their aiming (Kim et al., 2018). Studies have shown that participating in sports such as archery, football, and jumping can improve muscle quality and strength (Cvetković et al., 2018; Kim et al., 2018; Lutfiani & Irawan, 2025; Moran et al., 2018). Additionally, resistance training and specific techniques like eccentric loading and isometric exercises have been found to increase muscle mass, enhance endurance, and improve fatigue resistance (Amann et al., 2015; Suchomel et al., 2018).

Several studies have highlighted the significant differences in muscle strength between sedentary individuals and athletes. A study by Steffl et al., (2017) found that physically active individuals exhibited greater handgrip strength compared to sedentary individuals, suggesting that regular physical activity positively influences upper body strength. Similarly, a study by Cronin et al., (2017), which observed that young athletes participating in sports such as basketball and soccer tend to have superior handgrip and upper body strength relative to non-athletic peers.

Despite extensive research on muscle strength, limited studies have directly compared sedentary individuals with archers, particularly in upper body and handgrip strength. Understanding these differences is crucial especially in youth, as adolescence is a key period for muscle development and physical conditioning (Assunção et al., 2016). With modern technology and academic demands contributing to prolonged inactivity, youth are increasingly at risk of muscle weakness and early-onset deterioration (Jung et al., 2023). Currently, 31% of the global population is classified as inactive (Strain et al., 2024), with 60% of Malaysian adults leading sedentary lifestyles (Lian et al., 2016).

Given these concerns, examining the impact of archery training on muscle strength in youth can provide valuable insights into the benefits of sports participation and its role in long-term physical development. Most existing research has focused on differences in strength between active and inactive adults, but limited studies have specifically assessed youth populations. This study aims to address this gap by comparing handgrip and upper body strength between sedentary individuals and archers. Thus, contributing essential data on the role of archery training in strengthening key muscle groups and enhancing overall physical performance.

Materials and methods

Study participants

In this study, the participants were recruited through purposive sampling method. The sample size for this study was calculated using G Power software. The power was set at 0.8 and the alpha level at 0.5. A total of 36 participants were needed for this study which further divided

into 2 groups. After considering the 10% dropout rate, 4 more participants were recruited. A total of 40 participants were recruited for this study. Thus, each group consisted of 20 participants and were age matched.

Twenty (n= 20; male= 11 and female=9) youth archers with mean age of 14.7 ± 1.22 years old and twenty (n=20; male= 11 and female=9) sedentary school students with mean age of 14.8 ± 1.15 years old were recruited in this study. The participants of archer group were under the archery development program and represented their state at the national level tournament. The participants of sedentary group were secondary school students that did not represent any sports activity. Any participants with injuries in the past three months before the data collection process were excluded for participating in this study.

Ethical approval was obtained from the Human Research Ethics Committee of Universiti Sains Malaysia (USM/JEPeM/KK23010045). Also, official permission has been granted from the Director of Kelantan State Sports Council and the principal of a secondary school from Kelantan. Informed consent forms were given to all the participants after the briefing sessions. Only participants who agreed and signed the consent form were recruited. Participants under the age of 18 years have their forms approved and co-signed by their parents. All the protocols of this study conformed to the ethical guidelines of the 1975 Declaration of Helsinki.

Study organization

This is a cross-sectional study. The body height, body weight, body composition, handgrip strength and body strength were measured in this study.

The body height (cm) was measured using a stadiometer (Seca 220, Hamburg, Germany). Participants' body weight and body composition components including percentage of body fat and body mass index were measured using a "foot-to-foot" body composition analyser (Tanita model TBF-140, USA).

The handgrip strength (kg) was measured using a hand dynamometer (Jamar J00105, USA). The participants were required to hold the handgrip dynamometer in the tested hand. The arm was placed at the side of the body and the elbow at a 90-degree angle. Once ready, the participants grasped the dynamometer with maximum isometric effort and maintained it for 5 seconds. The test was conducted three times each for both hands alternately. The average of the three trials was used for analysis of results.

The upper body strength (m) was measured via medicine ball throw test. The participants were required to sit on the floor with legs fully extended and positioned about 60 cm apart. Their backs were firmly pressed against a wall. A medicine ball of three kilograms was held with both hands and placed at the centre of the chest, and the hands were on the sides of the ball. The forearms were required to be positioned parallel to the ground. Once ready, the participants threw the medicine ball as far forward as possible while maintaining their backs against the wall. The distance thrown was then measured and the test was conducted three times. The average of the three trials was used for analysis of results.

Statistical analysis

Statistical analyses were conducted using SPSS version 28, with significance level set at $p\text{-value} < 0.05$. The physical characteristics and body composition of the participants were compared using Independent T-test. Meanwhile, handgrip strength and upper body strength between the archers and sedentary group were compared using the Mann-Whitney test as the variables were not normally distributed.

Results

Physical characteristics and body composition of the participants

The mean age of all the participants was 14.76 ± 1.17 years old. There was significant difference in the body weight, body mass index (BMI) and body fat percentage between the two groups. The archer group was shown to have a heavier weight and higher body fat percentage than the sedentary group. There were no statistically significant differences found in the age and body height between the groups [Table 1](#).

Table 1. Comparison of age, body height, body weight, body mass index and body fat percentage between the archer group and sedentary group

	Mean (SD)		p-value
	Archer group (n=20)	Sedentary group (n=20)	
Age (year)	14.70 (1.22)	14.80 (1.15)	0.791
Body height (cm)	163.23 (5.55)	158.95 (8.25)	0.062
Body weight (kg)	63.13 (15.67)	48.70 (12.58)	0.003*
BMI (kg/m ²)	23.58 (5.08)	19.14 (3.82)	0.003*
Body fat percentage (%)	26.69 (9.22)	20.48 (9.86)	0.046*

SD, standard deviation; BMI: Body mass index

*, $p < 0.05$, significantly different between archer group and sedentary group

Comparison of handgrip strength and upper body strength

Based on the result of the Mann-Whitney test as illustrated in [Table 2](#), the archer group has a significantly stronger handgrip strength in both arms than the sedentary group ($p < 0.05$). Furthermore, the dominant hand was with higher handgrip strength values than the non-dominant arm in both groups. Other than that, the upper body strength in archer group was significantly higher than the sedentary group ($p < 0.05$).

Table 2. Comparison of dominant and non-dominant handgrip strength and upper body strength between archer group and sedentary group

	Median (IQR)		p-value
	Archer group (n=20)	Sedentary group (n=20)	
Handgrip strength of dominant arm (kg)	35.00 (7.75)	25.00 (14.83)	0.006*
Handgrip strength of non-dominant arm (kg)	29.00 (6.5)	23.67 (10.42)	0.012*
Upper body strength (m)	3.18 (0.92)	2.78 (0.84)	0.033*

IQR, interquartile range

*, $p < 0.05$, significantly different between archer group and sedentary group

Discussion

This study aimed to compare the hand and upper body strength between archers and sedentary individuals. The results demonstrate that archers exhibit significantly greater muscle strength in both hands and upper body than the sedentary individuals [Figure 1](#). Specifically, the handgrip strength of the dominant arm in archers (35.00 ± 7.75 kg) was significantly higher than in the sedentary individuals (25.00 ± 14.83 kg). Similarly, the non-dominant arm of archers (29.00 ± 6.5 kg) had greater strength than the sedentary individuals (23.67 ± 10.42 kg). Additionally, the upper body strength of archers (3.18 ± 0.92 m) was significantly higher than the sedentary group (2.78 ± 0.84 m). This observation is consistent with previous research

suggesting that athletes generally possess superior muscle quality relative to inactive individuals (Kalata et al., 2020).

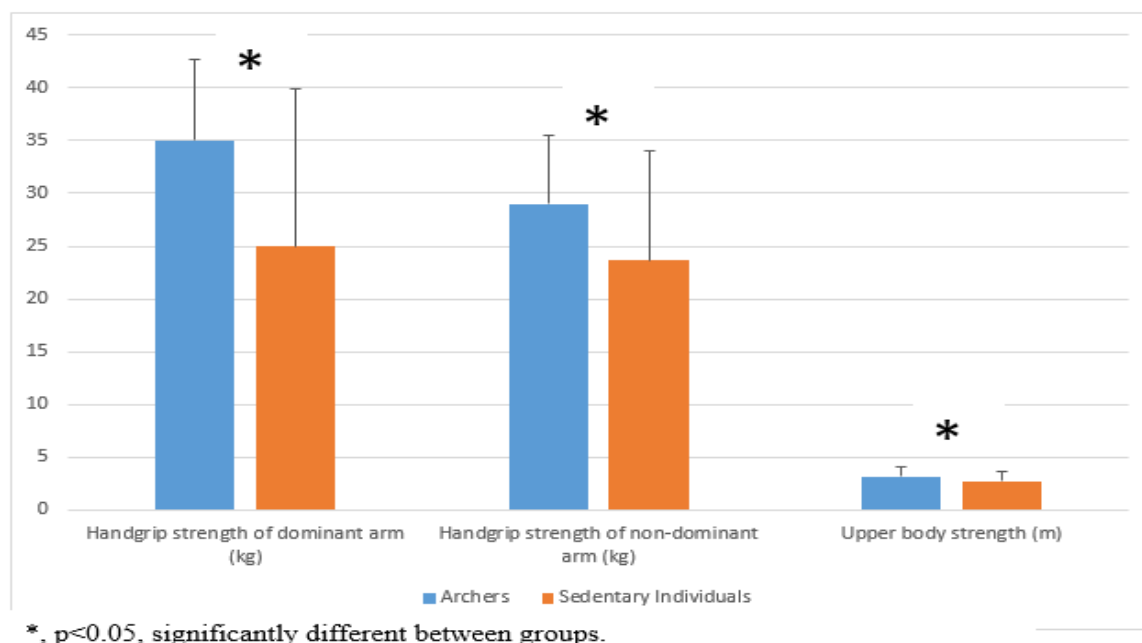


Figure 1. Comparison of dominant and non-dominant handgrip strength and upper body strength between archer group and sedentary group

Specifically, this finding aligns with those who reported archers had better muscular strength compared to non-athletes (Juliana et al., 2020; Mohd Saleh et al., 2022). The greater muscle strength in both hand and upper body of the archers than the sedentary individuals observed in the present study is likely due to the unique demands of archery, which heavily engage the upper limbs and upper body (Shinohara & Urabe, 2018). The repetitive isometric contractions during the string drawing and aiming phases (Simsek et al., 2018) increase localized blood flow, promoting hypertrophy and increasing the proportion of type I muscle fibres (Amann et al., 2015). In turn, this will benefit archers by giving them greater muscular strength compared to sedentary individuals.

Archery training requires athletes to engage in sustained muscle contractions. During the drawing phase, the archer pulls the string with the dominant hand towards the anchor position, engaging the isotonic contractions of arm muscles, while the non-dominant hand maintains an isometric contraction to hold the bow steady towards the target (Zolkafi et al., 2020). This movement pattern is similar to resistance training, further contributing to muscle strength development, especially in archers using loads of 35 to 40 pounds (Assunção et al., 2016). Thus, archery training benefited archers by enhancing their muscle quality and strength.

This current study also supports the findings of Zolkafi et al. (2020), which demonstrated that isometric contraction during archery training improves handgrip and upper body strength. Notably, this strength gains remain significantly elevated even after a period of detraining. Additionally, a study by Juliana et al. (2020) revealed that youths involved in archery training exhibited significantly higher upper body muscle strength compared to those who were not involved in such training. Therefore, it was speculated that the improvement in handgrip and upper body muscle strength following structured archery training is attributed to the consistent activation of muscles each time archers shoot arrows.

Handgrip strength is a crucial factor in archery performance, as it enhances arm-hand-steadiness which reduce the hand tremors during the aiming process and improves shooting accuracy (Sezer, 2017). Furthermore, archery is a sport that is performed in an open space where wind blows may affect the precision of shooting (Park, 2021). Archers need to be able to handle the bow during strong wind blows and stronger handgrip strength may ease the problem. Hence, the archers tend to have better strength than the sedentary group.

This study also showed that the handgrip strength of the dominant arm of the participants from both groups were stronger than the handgrip strength of the non-dominant arm. It was speculated that the reason could be all the participants tend to use the dominant hand more frequently than the non-dominant hand. The present study also found that the dominant hand of the archers was much stronger than the non-dominant hand if compared to the sedentary group. This could be due to the archers frequently using their non-dominant hand to hold the bow and aim while the dominant hand is used to pull the string and release the arrow (Zolkafi et al., 2020). The left deltoid is activated for the bow-pushing movement while the right biceps brachii and brachialis muscles are activated for the string-pulling movement (Ariffin, 2020). The present finding reflects that archers activated more in the right-hand muscle than the left hand muscle during shooting.

Another remarkable finding of this study is that the archers have better upper body strength than the sedentary individuals. Archers are required to have a strong upper body to draw the bow and hold it with correct static posture for 3 to 10 seconds and execute the skill repeatedly (Putra, 2022). Without sufficient upper muscle strength, the archer is unable to withstand the pull force of the bow or maintain stability during shooting.

Given the importance of handgrip and upper body strength in archery and overall health, structured programs should be considered for individuals with reduced strength. Sedentary individuals can improve their handgrip strength by incorporating resistance training such as wrist curls, farmer's carries, and hand grippers (Abe et al., 2023). Meanwhile, isometric and eccentric exercises, including planks and slow-resistance movements can effectively build upper body strength (Douglas et al., 2017). Furthermore, progressive overload and bilateral strength training can help in minimizing muscle imbalances (Drozd et al., 2024), particularly in archers due to the sport's asymmetrical nature.

In summary, the findings of this study indicate that archers exhibit significantly greater handgrip and upper body strength compared to sedentary individuals. This difference is attributed to the unique physical demands of archery, which involve repetitive isometric and isotonic contractions. These results reinforce the idea that sports participation, particularly in archery, can enhance muscle strength and overall physical performance.

Conclusions

In conclusion, the results conclusively demonstrated that archers possess greater handgrip and upper body strength compared to sedentary individuals. Future studies with additional parameters such as cardiovascular endurance, flexibility, balance, and reaction times are recommended for providing more comprehensive insights for coaches.

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Conflict of interest

There is no conflict of interest reported between the authors.

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