# The Effect of Dominant Side on The Lower Extremity Flexibility in Adolescent Shooting Athletes

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## 1. Introduction

Flexibility is known to be influenced by personal characteristics such as age, gender, and body type, as well as by the specific sport (1). Some researchers have suggested a negative relationship between flexibility and muscle strength in athletes (2,3). However, research does not provide a consensus on the relationship between flexibility and trunk strength in shooting athletes (4,5). Yapıcı et al. reported a relationship between flexibility and trunk strength in shooting athletes (6).

Shooting athletes are observed to maintain a static posture for long periods during training and competitions (4,6). Air rifle shooters shoot in a position involving head and trunk rotation and lateral flexion and typically do not move much between rounds. The highest level of technical proficiency is required to perform at an elite level. Target stability, postural control, emotional condition, and mental skills are all crucial (7).

There are no studies yet examining the effect of the dominant extremity on lower extremity flexibility in air rifle shooters. The purpose of this study was to investigate the effect of the dominant extremity on lower extremity flexibility and the relationship between lower extremity flexibility and core muscle strength in air rifle shooters.

## 2. Materials and Methods

This study included adolescent air rifle shooters from Çankırı. The athletes' demographic information—age, height, weight, sports experience, and dominant extremity used for shooting—was collected. Body mass index (BMI) was calculated based on height and weight data. In addition to demographic information, lower extremity flexibility and core muscle strength were assessed. The sit-and-reach test was used to evaluate lower extremity flexibility, with measurements taken for both the right and left lower extremities and recorded in centimeters (8). Core muscle strength was assessed using the trunk flexion endurance test, the right and left side plank tests, and the Sorensen test. Results were recorded in seconds (9). Examples of the tests are shown in Figure 1.

Data analysis was performed using SPSS 24.0 (IBM SPSS Statistics for Windows, Version 24.0, IBM Corporation, Armonk, NY, USA). The normality of the data distribution was tested using the Shapiro-Wilk test. Mean and standard deviation values were reported for normally distributed data, while median and interquartile ranges were reported for data that were not normally distributed. Paired sample tests were used for comparisons. Pearson correlation analysis was employed for normally distributed data, while Spearman correlation analysis was used for non-normally distributed data. Statistical significance was accepted as $p \leq 0.05$.

## 3. Results

The average age of the athletes (8 female, 6 male) was 15 (±0.51) years. The average BMI was 21.63 (±1.04) kg/m², and the average sports experience was 27 (±6.52) months. The right side was the dominant extremity for all athletes in the study. Demographic information of the athletes included in the study is shown in Table 1 and Table 2.

The sit-and-reach test results showed that the flexibility of the right lower extremity was 32.79 (±1.62) cm, while the flexibility of the left lower extremity was 30.18 (±1.57) cm. The flexibility of both lower extremities was 27.86 (±1.44) cm. The data for lower extremity flexibility are shown in Table 3.

The core muscle strength test results showed that the median duration of the trunk flexion endurance test was 69.00 (IQR: 56.75) seconds. The mean duration of the right side plank test was 63.29 (±12.32) seconds, the mean duration of the left side plank test was 59.79 (±10.70) seconds, and the mean duration of the Sorensen test was 174.93 (±28.49) seconds. The core muscle strength results are shown in Table 4.

In the comparison of the right and left sides, the sit-and-reach test results showed significantly greater flexibility in the right lower extremity compared to the left ($p<0.0001$). No significant differences were found between the right and left side plank tests ($p>0.05$). The results of the comparison tests are presented in Table 5.

When evaluating the relationship between flexibility and core muscle strength tests, no significant correlation was found between flexibility and core muscle strength ($p>0.05$). The correlation table is shown in Table 6.

## 4. Discussion

This study found that the flexibility of the dominant lower extremity was greater in adolescent air rifle shooters, and that lower extremity flexibility did not correlate with core muscle strength. Similar to the study by Akınoğlu et al., no correlation was found between core muscle strength and flexibility in shooting athletes (5). Diler et al. suggest that flexibility influenced shooting performance (10). Ertürk et al. found that the effect of flexibility on shooting success was 34% (11). Although this study did not directly analyze shooting performance, it was clear that flexibility plays an important role in shooting athletes, especially given the static posture required during shooting.

Shooting athletes compete in different disciplines, making it challenging to draw consistent conclusions about trunk performance across these athletes. However, it is reasonable to assume that air rifle shooters and archery athletes share similar characteristics, and comparisons could be drawn between these sports. Research has shown that flexibility and muscle strength tend to be greater in the dominant sides of athletes in various sports (12,13). Mair et al. reported that athletes in asymmetric sports have greater range of motion in their dominant extremities (14). Core muscle strength is important in order to be successful during shooting and to tolerate the reaction force that occurs (15).

Air rifle shooters have the ability to reduce body sway before shooting. This can be achieved by affecting postural control, respiratory control, and pulse decreasing (16). The organization of trunk muscles, upper extremity muscles, pelvic muscles, and lower extremity muscles becomes important in postural control (17–19). Trunk muscles, in particular, continue to work actively to maintain body balance against unexpected biomechanical changes (20). In addition, when we consider the direct relationship between respiratory control and core muscles, it may be expected that core muscles are equally strong. This may explain why the side plank times of the athletes in our study were not affected by the dominant side.

Target stability is important in air rifle shooting (21). Kocahan et al. reported that different muscle strengths are expected in the upper extremity and related muscles due to the asymmetrical stance in the shooting posture, but the isometric strengths of the shoulder's muscles are similar (22). During shooting, the stiffness of the pelvic and leg muscles rather than active muscle contraction plays an important role in target stability (23). We think that the core muscles are not affected by the dominant extremity due to the importance of postural control, but the flexibility of the lower extremity is affected due to the asymmetrical posture.

This study has several limitations: Postural analysis was not performed on the athletes included in the study. The dominant side of all participants was the right side.

## 5. Conclusion

Based on the results, we conclude that lower extremity flexibility is influenced by shooting posture and the dominant extremity. Although no correlation was found between lower extremity flexibility and core muscle

strength, we recommend incorporating flexibility and strength exercises to improve body symmetry and enhance shooting performance, particularly considering the athletes' young age and limited experience.

## References

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