

# Foot Dominance and Function

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## INTRODUCTION

In the field of podiatric medicine, a vast majority of injuries to the feet are observed but the link between a patient's dominant foot and the injuries they are prone to is still premature. Having a dominant foot is derived from the concept of laterality. Laterality is a term used to designate the asymmetrical use of limbs or sensory organs (1). The human body is characterized by asymmetrical dominance pertaining to the majority of its components. A person's laterality is influenced by the physical development and changes induced by cultural and environmental factors (2) making it an important aspect of human development and function. It is not solely a trait specific to humans but has been recognized among other species. Recent evidence shows that nearly 70% of nonhuman vertebrates have exhibited limb preferences (3).

The notion of laterality is mostly familiar to the public based on the concept of having a dominant hand. Having a dominant hand is understood globally and culturally and is gaining more traction towards being utilized in research. In 2013, a study conducted by Marciniowski et al, predicted that infants with a hand preference would develop cognitive skills earlier, and found that a hand preference did relate to earlier development of object stacking skills (4). In humans, handedness is the most-widely studied lateral preference, but a similar asymmetrical use has been described for other paired organs such as feet, eyes, and ears (1). The results of a study conducted by Tran and Coracek in 2016, reported that footedness is a more relevant predictor of motor abilities and sporting performance than handedness, and is less subjected to cultural biases (5). Handedness has always been considered a reliable predictor for language dominance, but subsequent findings stress a close relation between language dominance and footedness, suggesting foot preference may be a superior indicator for language laterality (3). These findings illustrate the importance of studying laterality as it pertains to the lower extremity, particularly the foot. Various studies have already been conducted in trying to understand the effects of foot dominance across the board ranging from the effect it has on playing sports to the effects displayed

when evaluating musculoskeletal disorders. However, there is still a need for a podiatric focused study regarding the dominant foot as it pertains to the biomechanic, pathologic, and neurologic aspects of patients.

## METHODS

We decided to focus on 2 studies conducted in 2019 that focused on foot dominance and its effects on playing sports and musculoskeletal disorders, specifically *The Evaluation of Musculoskeletal Disorders Seen in Footballers with Regard to Dominant Foot Preference* (6) and *The Effect of Unilateral and Bilateral Foot Dominance on Sprinting Speed of Young Athletes* (7).

Tanir et al (6) utilized primary research in the form of questionnaires to collect data. Their research sample consisted of 40 male football players, age range 14-18 years from the Aydin Incirliova Sport High School in the school year of 2018-2019. The Waterloo Handedness Questionnaire created by Elias et al was utilized to determine the dominant foot. The Cornell Musculoskeletal Disorders Questionnaire was implemented in order to determine the frequency and severity of musculoskeletal disorders in 18 parts of the body and whether these disorders affected working capacity. The data collected were then analyzed using SPSS 22.0 software with 95% confidence intervals and a significance level of  $P = 0.105$ . The Kolomogrov-Smirnov test was used to exhibit normal distribution and then an independent sample t-test to test the difference between the 2 sample groups based on averages. Age, height, weight, and body mass index were also incorporated into the data collection.

Selcuk et al (7) collected data from 156 males and 37 females who were participating in the entrance examination for schools of physical education and sports in Yuzuncu Yil University in 2015. The research entailed participants sprinting from a standing position with one foot placed on the start line. Two runs were conducted at the person's maximum speed, over a 30-meter distance. The person's foot dominance was then determined by asking them to kick a soccer ball and they were later asked if they had the

ability to kick the ball with just their right foot, left foot, or both placing them in different categories (unilateral footed or bilateral footed). The Kolmogorov-Smirnov Test was also used to exhibit normal distribution and the Mann Whitney-U test was used to test the difference between the 2 groups.

## RESULTS

In the study by Tanir et al, the average age of the football players was  $16.20 \pm 0.96$  years, the average length was  $1.68 \pm 0.08$  cm, and body weight was  $59.40 \pm 8.56$  kg. The average body mass index was  $20.75 \pm 1.91$  kg/cm<sup>2</sup>. There was no statistical significance found in terms of difference between the left and right-footed players based on the types of injuries seen in the upper extremity ( $P > 0.05$ ). This suggested that a player's dominant foot does not affect injuries that occur in the upper extremity. In regard to injuries located in the lower extremity, there was statistical significance found in terms of injuries exhibited in the left upper leg, left knee, and left lower leg ( $P < 0.05$ ). They discovered that right-footed players experienced an increase in injuries on their left upper leg, left knee, and left-lower leg when compared to the left footed-players. There were no significant differences recognized between right- and left-footed players when analyzing injuries located in the hip, right upper leg, right knee, and right lower leg ( $P > 0.05$ ).

In the study by Selcuk et al there was no significant difference between unilateral and bilateral footers in terms of sex. There were 156 males in this study (127 unilateral footed and 29 bilateral footed), 102 were right footed, 25 were left footed, and 29 were bilateral. There were 37 females in this study (29 unilateral footed and 8 bilaterally footed), 28 were right footed, 6 were left footed, and 3 were bilateral. There were significant differences noted in the second 30 meter run between 2 groups of males who were physically similar. In the first sprint, the male average sprint speed was 6.88 meters/second (unilateral footed) and 6.95 meters/second (bilateral footed). In the second sprint, the male average sprint speed was 6.93 meters/second (unilateral footed) and 7.93 (bilateral footed). The average sprint speed for unilateral footed females was 5.59 meters/second and for bilateral footed females, 6.35 meters/second in the first sprint. In the second sprint the average was 5.67 meters/second for unilateral footed and 6.33 meters/second for bilateral footed.

## DISCUSSION

Based on the studies reviewed, it is evident that the concept of foot dominance holds truth. Being right- or left-footed determines human capability as well as muscular destruction that we are prone to. The concept of mobilization and stabilization plays a crucial role in determining the dominant foot. Investigation in adults has revealed that mobilization tasks are featured by a strong and well-defined preference for a single foot, predominantly the right one (8). Bilateral-footed athletes are superior in terms of neurologic and mechanical advantage when playing sports in comparison to unilateral-footed athletes. Bilateral muscle groups are utilized frequently and maintain a sense of equal strength, protecting them from musculoskeletal injuries.

With dominance comes favoritism and the increased use of one extremity leading to an increase in muscle strength and ability while simultaneously a decrease in muscle strength and ability of the other extremity. It has been foreseen that athletes are more prone to injuries in the non-dominant foot. For example, athletes, such as soccer players, are more likely to injure their non-dominant foot because of insufficient strength (6). This comes as no surprise because with a decrease in utilization of an extremity, comes muscle weakness, leading to an increase in injury. A correlation can be made between the knowledge that the dominant foot is utilized more for actions that require power and strength, which results in asymmetric development of the right and left foot/legs. Having minimal sample size, data, and exploration of topics pose some limitation to our review and this study may be enhanced by including these factors.

In conclusion, the concept of laterality is important because it can lead towards understanding of patient's injuries based on their activities. This knowledge will enhance the doctor's treatment plan and will bring the best results for the patient's healing potential. For example, if a patient is postoperative and must be non-weightbearing, it may be harder for them to be compliant based on whether it is their dominant or non-dominant foot that has been injured. There may be an increase in the patient's healing potential based on extremity dominance. Understanding dominance with regard to the foot is an amazing tool for podiatrists who can utilize this information within their biomechanic evaluations, musculoskeletal examinations, and neurologic examinations. We suggest that determining of foot dominance should be incorporated into all biomechanic and musculoskeletal foot examinations.

There is a need for research exploring the benefits of foot dominance when treating patients. A podiatry-focused study of the dominant foot could explore aspects of differences in weight-bearing load, deviation of joint axes, and limb-length discrepancies. These topics could help all podiatrists have a heightened understanding of common conditions such as hallux abducto valgus, hammertoes, pes planus, metatarsus adductus, posterior tibial tendon dysfunction, and other foot pathologies that may be associated with abnormal foot mechanics based on foot dominance.

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