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# Ankle Power Asymmetry Between the Dominant and Non-Dominant Limbs in Healthy Adults

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## ABSTRACT

**Background:** Ankle power is a critical component of lower limb biomechanics, influencing movement efficiency, athletic performance, and injury risk. Limb dominance may contribute to asymmetry in ankle power, potentially affecting functional outcomes and injury susceptibility.
**Objective:** To quantify ankle power asymmetry between dominant and non-dominant limbs in healthy adults.
**Methods:** A cross-sectional study was conducted among 70 healthy adults aged 18–30 years recruited from an orthopaedic outpatient department. Ankle plantarflexion and dorsiflexion power were measured bilaterally using a portable push–pull dynamometer and recorded in Newtons (N). Dominant and non-dominant limb values were compared using a paired t-test with a significance level of $p < 0.05$.
**Results:** Mean plantarflexion power was significantly higher in the dominant limb compared to the non-dominant limb (62.69 ± 11.99 N vs 61.56 ± 11.90 N; $t = 3.21$, $p = 0.002$). Dominant limb dorsiflexion power was also significantly greater (48.01 ± 10.29 N vs 47.23 ± 10.08 N; $t = 2.33$, $p = 0.023$).
**Conclusion:** Healthy adults exhibit a statistically significant ankle power asymmetry favoring the dominant limb for both plantarflexion and dorsiflexion. Quantifying ankle power asymmetry may aid in injury prevention, rehabilitation planning, and performance optimization.

***Keywords****: Ankle power; Limb dominance; Asymmetry; Dynamometry*

## INTRODUCTION

Ankle power plays a pivotal role in lower limb biomechanics by contributing to propulsion, balance, and efficient movement during functional activities such as walking, running, and jumping.[1] Adequate plantarflexion and dorsiflexion power are essential for athletic performance and injury prevention.[4] Limb dominance often results in asymmetrical loading patterns, particularly in tasks involving unilateral or repetitive movements.[2,3]

Previous biomechanical studies have demonstrated that the dominant limb typically generates greater propulsive forces, whereas the non-dominant limb contributes more to stabilization and braking.[2] Zifchock et al. reported consistent interlimb asymmetries in ground reaction forces that influence ankle joint kinetics during gait.[3] In high-intensity activities such as sprinting and jumping, athletes exhibit greater power output from the dominant limb.[5]

Although mild asymmetries are considered physiological, excessive imbalances may alter movement mechanics and increase injury risk.[6] Despite existing research focusing on muscle strength and ground reaction forces, limited studies have directly quantified ankle power asymmetry using portable dynamometry. This study aimed to evaluate ankle power differences between dominant and non-dominant limbs in healthy adults.

## Methodology

This cross-sectional study included 70 healthy adults aged 18–30 years attending an orthopaedic outpatient department. Participants were recruited using consecutive sampling over a six-month period.

**Inclusion Criteria**

- Age 18–30 years
- No history of ankle injury

**Exclusion Criteria**

- Age <18 or >30 years
- Previous ankle surgery
- Neuromuscular disorders
- Congenital deformities

**Data Collection**

Ankle plantarflexion and dorsiflexion power were measured bilaterally using a portable push–pull dynamometer, a validated tool for ankle muscle assessment,[7] and recorded in Newtons (N). Limb dominance was identified based on the participant's preferred limb.

**Statistical Analysis**

Descriptive statistics were expressed as mean ± standard deviation (SD). Dominant and non-dominant limb values were compared using a paired t-test. Statistical significance was set at $p < 0.05$.

**Results**

A total of **70 healthy adults** (mean age: 22.8 ± 1.6 years) participated in the study. Both male and female participants were included, with right-side dominance observed in the majority of subjects.

Ankle plantarflexion and dorsiflexion power values were compared between dominant and non-dominant lower limbs using a paired t-test.

Mean ankle plantarflexion power was significantly higher in the dominant limb (62.69 ± 11.99 N) compared to the non-dominant limb (61.56 ± 11.90 N). This difference was statistically significant ($t = 3.21$, $p = 0.002$).

Similarly, dominant limb dorsiflexion power (48.01 ± 10.29 N) was significantly greater than that of the non-dominant limb (47.23 ± 10.08 N), with a statistically significant difference observed ($t = 2.33$, $p = 0.023$).

**Ankle Power Comparison Between Limbs**

| **Movement** | **Dominant Mean ± SD (N)** | **Non-dominant Mean ± SD (N)** | **p-value** |
|---|---|---|---|
| Plantarflexion | 62.69 ± 11.99 | 61.56 ± 11.90 | 0.002 |
| Dorsiflexion | 48.01 ± 10.29 | 47.23 ± 10.08 | 0.023 |

Both plantarflexion and dorsiflexion power were significantly higher in the dominant limb.

## Table 1 : Demographic data

| S.NO | NAME | AGE | SEX | DOMINANT SIDE | RIGHT ANKLE PLANTAR FLEXION | LEFT ANKLE PLANTAR FLEXION | DIFF | RIGHT ANKLE DORSI FLEXION | LEFT ANKLE DORSI FLEXION | DIFF |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | YUVARANI | 23 | F | R | 72 | 71 | 1 | 65 | 63 | 2 |
| 2. | SRINIDHI | 22 | F | R | 61 | 64 | 3 | 54 | 55 | 1 |
| 3. | SOWMIYA | 22 | F | R | 64 | 63 | 1 | 49 | 47 | 2 |
| 4. | SANJANA | 23 | F | R | 51 | 50 | 1 | 44 | 42 | 2 |
| 5. | BHOOMIKA | 24 | F | R | 52 | 54 | 2 | 44 | 45 | 1 |
| 6. | KARTHIGA | 22 | F | R | 51 | 50 | 1 | 47 | 44 | 3 |
| 7. | HARITHA | 22 | F | R | 61 | 58 | 3 | 50 | 47 | 3 |
| 8. | EBESHYAM | 23 | F | R | 52 | 52 | 0 | 44 | 43 | 1 |
| 9. | AISHVARYA | 23 | F | R | 64 | 60 | 4 | 52 | 50 | 2 |
| 10 | SATHISH KUMAR | 24 | M | R | 68 | 65 | 3 | 44 | 42 | 2 |
| 11 | MRIDULA | 21 | F | R | 64 | 69 | 5 | 52 | 55 | 3 |
| 12 | ATCHAYA | 21 | F | L | 56 | 60 | 4 | 41 | 44 | 3 |
| 13 | SHREE GUHAN | 23 | M | R | 59 | 59 | 0 | 43 | 42 | 1 |
| 14 | ABHAY | 22 | M | R | 69 | 71 | 2 | 56 | 57 | 2 |
| 15 | HARISH | 21 | M | L | 60 | 64 | 4 | 43 | 45 | 2 |
| 16 | NIJANTHAN | 24 | M | R | 71 | 70 | 1 | 56 | 60 | 4 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | KEERTHIVASAN | 22 | M | R | 76 | 77 | 1 | 64 | 62 | 2 |
| 18 | PRASANNA | 23 | M | R | 80 | 84 | 4 | 43 | 45 | 2 |
| 19 | MONISH KUMAR | 22 | M | R | 84 | 80 | 4 | 52 | 55 | 3 |
| 20 | VIRDAN KUMAR | 21 | M | R | 64 | 62 | 2 | 53 | 50 | 3 |
| 21 | MOUNISH | 23 | M | R | 80 | 80 | 0 | 55 | 57 | 2 |
| 22 | RAHSHIT SHANKAR | 22 | M | R | 77 | 73 | 4 | 45 | 41 | 4 |
| 23 | MOHAMMED IMRAN | 22 | M | R | 59 | 57 | 2 | 37 | 37 | 0 |
| 24 | PRAISY | 23 | F | R | 61 | 60 | 1 | 57 | 54 | 3 |
| 25 | NIVETHA A | 22 | F | R | 60 | 65 | 5 | 44 | 48 | 4 |
| 26 | PRIYADARSHINI | 23 | F | R | 53 | 49 | 4 | 57 | 55 | 2 |
| 27 | PAVITHRA | 26 | F | R | 61 | 61 | 0 | 53 | 50 | 3 |
| 28 | POOVIZHI | 22 | F | R | 50 | 46 | 4 | 53 | 49 | 4 |
| 29 | PRIYA | 23 | F | R | 66 | 66 | 0 | 52 | 53 | 1 |
| 30 | KISHOR | 22 | M | R | 60 | 56 | 4 | 45 | 47 | 2 |
| 31 | PRANESH RAJ | 24 | M | R | 77 | 79 | 2 | 55 | 55 | 0 |
| 32 | MELVIN THOMAS | 22 | M | R | 62 | 60 | 2 | 52 | 51 | 1 |
| 33 | POOJA | 22 | F | R | 66 | 62 | 4 | 45 | 41 | 4 |
| 34 | DHANYA | 22 | F | R | 64 | 60 | 4 | 35 | 32 | 3 |
| 35 | DHEVADHARSHINI | 25 | F | R | 72 | 68 | 4 | 30 | 34 | 4 |
| 36 | ANANYA | 22 | F | R | 77 | 73 | 4 | 37 | 32 | 5 |
| 37 | HARINI | 24 | F | R | 45 | 42 | 3 | 33 | 37 | 4 |
| 38 | SWATHI | 21 | F | R | 40 | 42 | 2 | 34 | 33 | 1 |
| 39 | AKSHAYA | 21 | F | R | 54 | 50 | 4 | 39 | 35 | 4 |
| 40 | SUSHMITHA | 22 | F | R | 73 | 70 | 3 | 38 | 36 | 2 |
| 41 | KAUSHIKA | 22 | F | R | 42 | 38 | 3 | 30 | 26 | 4 |
| 42 | BASHEER | 23 | F | R | 47 | 42 | 5 | 56 | 52 | 4 |
| 43 | JENITHA | 21 | F | R | 56 | 54 | 2 | 66 | 64 | 2 |
| 44 | THARANESAGARI | 22 | F | R | 71 | 65 | 5 | 72 | 68 | 3 |
| 45 | LOGAMITHRA | 21 | F | R | 61 | 56 | 4 | 53 | 48 | 5 |
| 46 | VARINGA | 23 | F | R | 57 | 53 | 4 | 29 | 24 | 5 |
| 47 | ALFA | 23 | F | R | 62 | 60 | 2 | 47 | 46 | 1 |
| 48 | SHRUTHI | 23 | F | R | 55 | 58 | 3 | 24 | 28 | 4 |
| 49 | SOORYAN | 23 | M | R | 68 | 68 | 0 | 62 | 63 | 1 |
| 50 | NIVETHA G | 22 | F | R | 40 | 37 | 3 | 40 | 42 | 2 |
| 51 | DEEPAK S | 23 | M | R | 56 | 53 | 3 | 37 | 35 | 2 |
| 52 | BROWLIN SHINNU | 24 | F | R | 31 | 34 | 2 | 33 | 30 | 3 |
| 53 | SAISRUTHI | 21 | F | R | 42 | 42 | 0 | 35 | 39 | 4 |
| 54 | SHREYA KOUSHIKA | 23 | F | R | 63 | 61 | 2 | 65 | 60 | 5 |
| 55 | SHREYA P | 23 | F | R | 52 | 56 | 3 | 46 | 50 | 4 |
| 56 | SANTHOSHI | 22 | F | R | 59 | 61 | 2 | 39 | 35 | 3 |
| 57 | SAMYUKTHA | 22 | F | R | 56 | 58 | 2 | 45 | 43 | 2 |
| 58 | SHRINIDHI | 22 | F | R | 63 | 60 | 3 | 42 | 45 | 3 |
| 59 | JAYASURYA | 23 | M | R | 83 | 80 | 3 | 39 | 38 | 1 |
| 60 | DHINESH | 24 | M | R | 88 | 85 | 3 | 53 | 57 | 4 |
| 61 | SHUBA | 24 | F | R | 61 | 65 | 4 | 52 | 50 | 2 |
| 62 | ANVAI | 23 | F | R | 65 | 61 | 4 | 60 | 58 | 2 |
| 63 | SANGESH | 23 | M | R | 68 | 70 | 2 | 44 | 48 | 4 |
| 64 | ASMA D | 35 | F | R | 57 | 52 | 5 | 52 | 50 | 2 |
| 65 | YOGESH KANNAN | 21 | M | R | 65 | 63 | 2 | 56 | 57 | 1 |
| 66 | DHARANEESH | 23 | M | R | 66 | 62 | 3 | 53 | 51 | 2 |
| 67 | TAMIZHMARAI | 23 | M | R | 90 | 87 | 3 | 68 | 65 | 3 |
| 68 | HARSHVARTHAN | 23 | M | R | 89 | 85 | 4 | 66 | 62 | 4 |
| 69 | YAMUNA | 24 | F | R | 62 | 65 | 3 | 50 | 48 | 2 |
| 70 | RAJ | 23 | M | R | 77 | 76 | 1 | 55 | 54 | 1 |

**Image 1: Push and Pull Dynamometer**


**Image 2: Measuring Ankle Plantarflexion with Dynamometer**

**Image 3: Measuring Ankle Dorsiflexion with Dynamometer**

## DISCUSSION

The present study demonstrates a statistically significant ankle power asymmetry favoring the dominant limb in healthy adults. These findings are consistent with previous studies reporting greater propulsive and power-generating capacity in the dominant limb during gait and athletic tasks.[2,5] Bishop et al. emphasized that repeated unilateral loading may accentuate interlimb asymmetries, potentially increasing injury risk if unaddressed.[6]

Although the magnitude of asymmetry observed in this study was relatively small, even subtle differences may influence movement efficiency and load distribution over time. The use of a portable push–pull dynamometer provides a practical, clinically applicable approach for assessing ankle power asymmetry in both research and rehabilitation settings.[7]

**Limitations**

The study was limited to a young, healthy population and did not assess long-term functional outcomes, sport-specific demands, or injury incidence.

**Conclusion**

Healthy adults exhibit statistically significant asymmetry in ankle plantarflexion and dorsiflexion power, with higher values observed in the dominant limb. Assessment of ankle power asymmetry using portable dynamometry may be valuable for clinical evaluation, injury prevention, and individualized rehabilitation planning.

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