How the Foot Modulates its Mechanics During Uphill and Downhill Walking

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INTRODUCTION

- The foot is often considered a rigid lever
  - Oversimplification
- Multi-segment foot modelling can capture the foot's mechanics [1]
- Uphill/downhill walking is well-studied [2], but the foot's role is relatively unknown
  - Uphill walking requires excess positive work to lift the body
  - Downhill walking requires excess negative work to lower the body
- Some foot structures may play a role in determining the foot's mechanics during sloped walking
  - e.g., plantar fascia, heel pad

PURPOSE

To identify the mechanical role of the foot during sloped walking in healthy, young adults.

HYPOTHESES

- Uphill walking will result in the foot generating greater amounts of mechanical energy (i.e., positive work) to supplement lifting the body's COM
- Downhill walking will result in the foot dissipating greater amounts of work (i.e., more negative work) to aid in slowing the body down

METHODS

- Healthy, young adults
- Walk on an treadmill (1.25 m/s)
- Slopes of -10°, -5°, 0°, 5°, and 10°
- 3D motion capture, force plates

RESULTS (N = 3)

- Uphill walking
  - Increased foot positive work
  - 0.20 ± 0.02 J/kg at 0° to 0.42 J/kg at 10°
  - p = 0.061, 109% increase
- Downhill walking
  - Increased negative foot work
  - -0.27 J/kg at 0° to -0.41 J/kg at 10°
  - p = 0.676, 52% increase

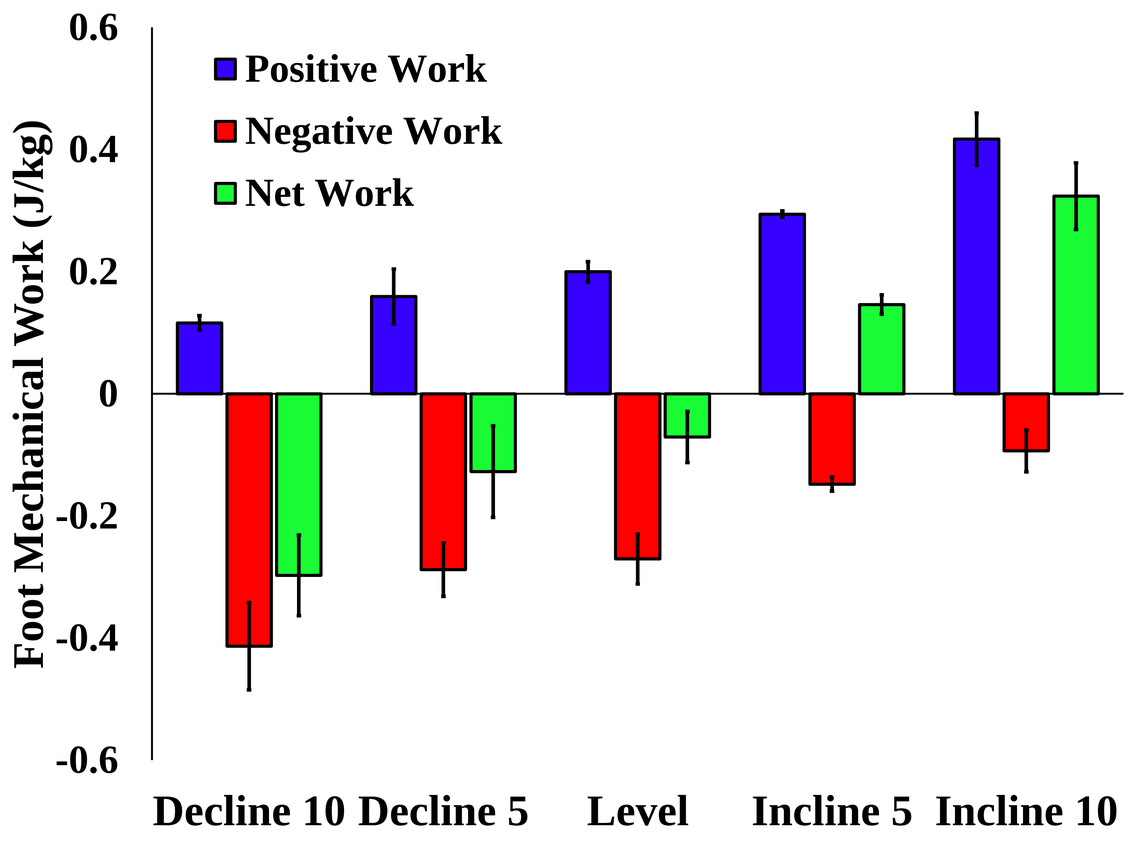

Figure 1. Positive, negative, and net work of the foot per step (J/kg) across sloped conditions (N = 3).

DISCUSSION & CONCLUSIONS

The foot appears to be able to adapt its mechanical work profile to the demands of sloped walking, specifically by increasing positive work during inclined walking and dissipating more energy during declined walking.

REFERENCES

[1] Takahashi, KZ, et al. (2017). *Sci Rep*., **7**, 15404.
[2] Franz, JR, et al. (2012). *J Biomech*, **45**, 257-262.

ACKNOWLEDGEMENTS

Research reported in this publication was supported by the National Institute on Aging of the National Institutes of Health under Award Number F31AG057135. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.