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Surface, but Not Age Impact Lower Limb Joint Work During Walk and Stair Ascent

Thomas A. Wenzel
Boise State University

Nicholas L. Hunt
Boise State University

Amy E. Holcomb
Boise State University

Clare K. Fitzpatrick
Boise State University

Tyler N. Brown
Boise State University

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Abstract

During common locomotor activates, such as walk or stair negotiation, older adults exhibit unfavorable lower limb biomechanical changes, including diminished joint torque and power, and proximal mechanical work redistribution that may increase their fall risk. Twelve young (18 to 25 years) and 12 older (> 65 years) adults performed a walk and stair ascent task on a normal, slick, and uneven surface. For each walk and stair ascent trial, synchronous 3D marker trajectories and GRF data were collected. Stance phase positive limb and joint work, and relative joint work were submitted to statistical analysis. Ascending stairs required more positive work than the walk, particularly from the knee, which may increase fall risk. Yet, both walking and ascending stairs over a challenging surface required more, proximally distributed work.

SURFACE, BUT NOT AGE IMPACT LOWER LIMB JOINT WORK DURING WALK AND STAIR ASCENT

Thomas A. Wenzel, Nicholas L. Hunt, Amy E. Holcomb, Clare K. Fitzpatrick & Tyler N. Brown

INTRODUCTION

Age-related loss in lower limb strength, particularly ankle, may *impair older adults (over 65 years of age) mobility, and result in biomechanical deficits* compared to their younger counterparts.

Older adults tend to walk slower with shorter steps and *exhibit diminished ankle joint kinetics* (i.e., moment, power and work).

Although older adults produce smaller ankle torque and power, it is unclear if they *redistribute lower limb, or increase hip or knee power to walk*, particularly on challenging (e.g., uneven or slick) surfaces.

PURPOSE: To investigate age-related differences in lower limb work during a walk and stair ascent task on challenging surfaces.

METHODS

Participants: 12 young (18 to 25 years;) and 12 older (> 65 years) performed 3 trials of a walk and stair ascent task on the normal, slick, and uneven surfaces (**Fig. 1**).

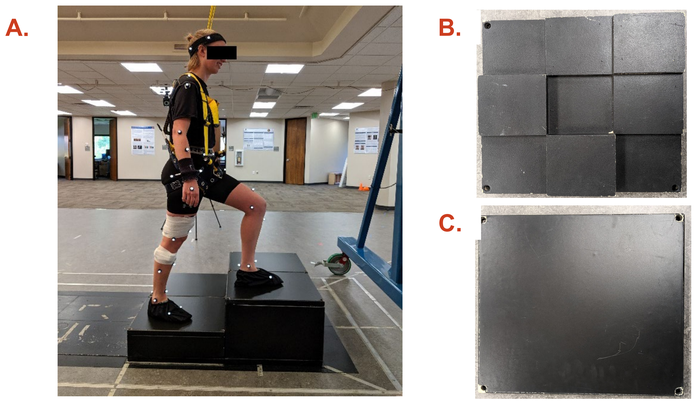
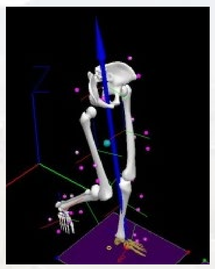


Figure 1: Stair ascent task required participants step up two stairs (rise: 18.5 cm) (**A**) outfitted with normal, uneven (**B**), and slick surfaces (**C**).

Biomechanical Analysis: Synchronous 3D marker trajectories and GRF data were recorded with motion capture and processed in Visual3D to obtain sagittal plane lower limb biomechanics.

Motion Capture

Sagittal Plane Biomechanics

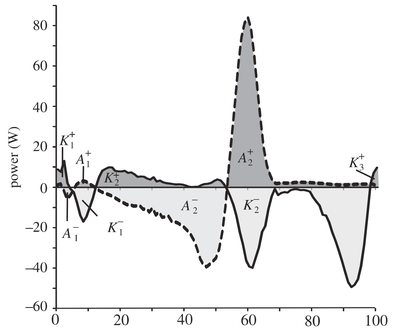


METHODS

Joint Power:

Stance phase hip, knee and ankle joint power were calculated.

Then, individual periods of positive work (dark grey) were calculated and summed across stance at each lower limb joint.



Statistical Analysis:

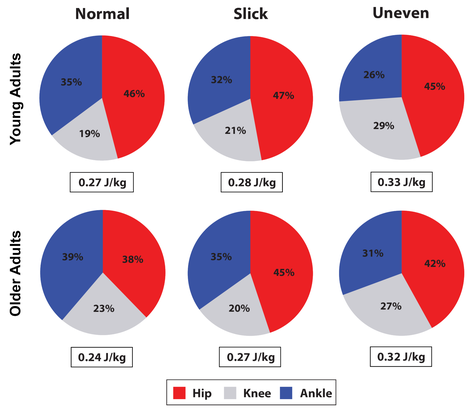
Limb / Joint Work
Relative Effort (% of total)

→ **ANOVA** ← **Age**, ← **Surface**

*** α = 0.05**

RESULTS

Participants produced more positive limb, hip, knee, and ankle work during the stair ascent compared to walk task (all: $p < 0.001$).

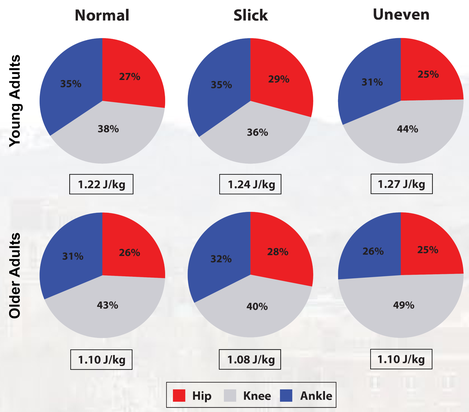


During the walk:

- Percent hip contribution to total power increased ($p < 0.001$).
- Percent knee increased ($p < 0.001$), but ankle decreased ($p < 0.001$) power contribution on challenging surfaces.

During the stair ascent:

- Knee increased percent power contribution ($p < 0.001$).
- Percent hip increased on slick, knee increased on uneven, and ankle decreased contribution on uneven surface (all: $p < 0.001$).



RESULTS

Surface, but not age impact limb and joint work production.

During the walk, surface impacted limb ($p < 0.001$), hip ($p = 0.010$), and knee ($p < 0.001$) positive work production (**Fig. 2**).

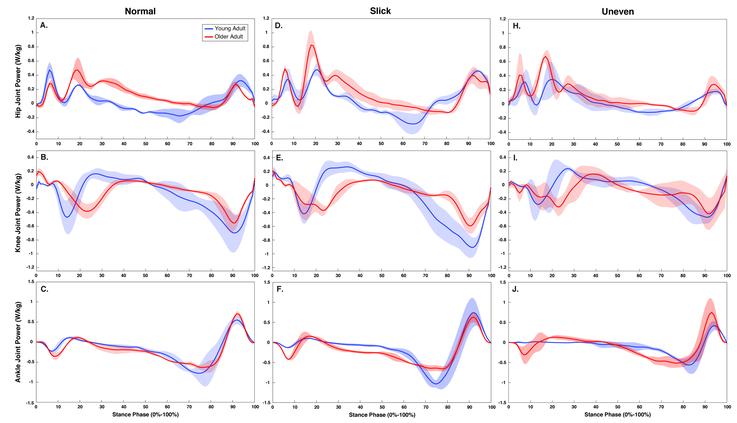


Figure 2. Stance phase hip, knee, and ankle joint power for young and older adults during the walk task on each surface.

During the stair ascent, surface impacted hip ($p = 0.015$), knee ($p < 0.001$), and ankle ($p = 0.010$) positive work production (**Fig. 3**).

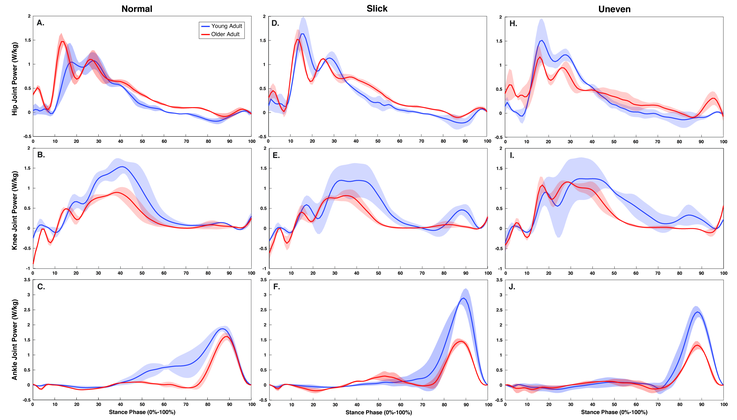


Figure 3. Stance phase hip, knee, and ankle joint power for young and older adults during the stair ascent task on each surface.

KEY FINDINGS:

1) Challenging surface and not age impacted lower limb work.

2) On the challenging surfaces, individuals increased hip and knee, but decreased ankle work.

ACKNOWLEDGEMENTS

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