# SURFACE, BUT NOT AGE IMPACTS LOWER LIMB JOINT WORK DURING STAIR ASCENT

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## 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 stair ascent task on challenging surfaces.

## METHODS

**Participants:** 24 (12 young: 18 to 25 years; 12 older: over 65 years, with one accidental fall in last year) adults participated.

**Task:** Each participant performed 3 trials of the stair ascent task on the normal, slick, and uneven surfaces (**Fig. 1**).

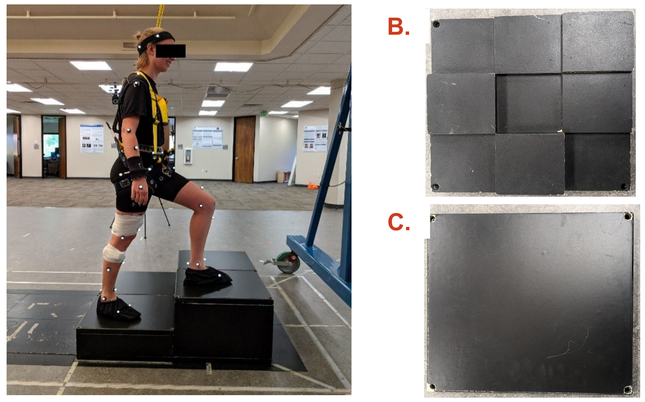
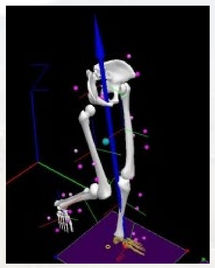



**Figure 1:** Stair ascent task required participants step up two stairs (rise: 18.5 cm) (**A**) outfitted with normal, uneven (**B**), and slick surfaces (**C**).

**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.

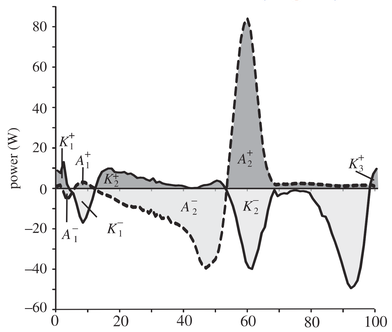
**Motion Capture**

**Sagittal Plane Biomechanics**



## METHODS

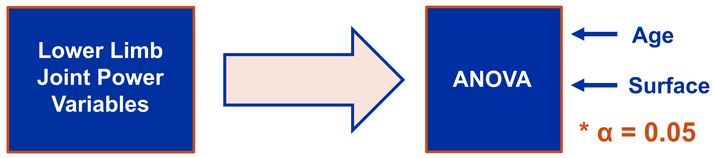
**Joint Power:** stance phase (0% - 100%) at each lower joint (hip, knee and ankle) was calculated in Visual3D, and then positive work calculated across stance (**Fig. 2**).




Individual periods of positive work (dark grey) and negative work were calculated separately by integration using the trapezium rule at each lower limb joint.

**Figure 2:** Depicts stance phase (0% - 100%) knee and ankle joint power.

**Dependent Variables:** Total limb, hip, knee and ankle positive work, and relative effort (% of total) were submitted to statistical analysis.




## RESULTS

Surface, but not age on impacted lower limb work. Specifically, surface impacted total limb ($p<0.001$), hip ($p=0.007$) and knee ($p=0.001$) positive work (**Fig. 3**).

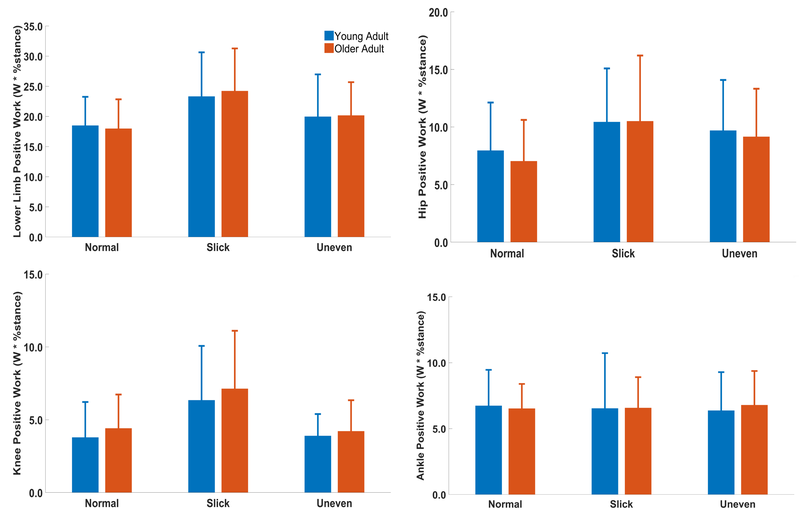



**Figure 3.** Mean ± SD for positive work for the limb (A), hip (B), knee (C), and ankle (D) for young and older adults on each surface (normal, uneven, and slick).

## RESULTS

The limb and knee produced more positive work on the uneven compared normal ($p<0.001$; $p=0.002$) and slick ($p=0.005$; $p<0.001$) surfaces. The hip produced more positive work on uneven and slick compared to normal surface ($p=0.029$; $p=0.049$).

Surface also impacted relative knee ($p=0.029$) and ankle ($p<0.001$) work, but not hip relative work (**Fig. 4**).

Knee relative work was greater on the uneven compared to slick surface ($p=0.019$). Ankle relative work was greater on the normal compared to uneven ($p<0.001$) and slick ($p=0.028$) surfaces, and on the slick compared to uneven surface ($p=0.017$).

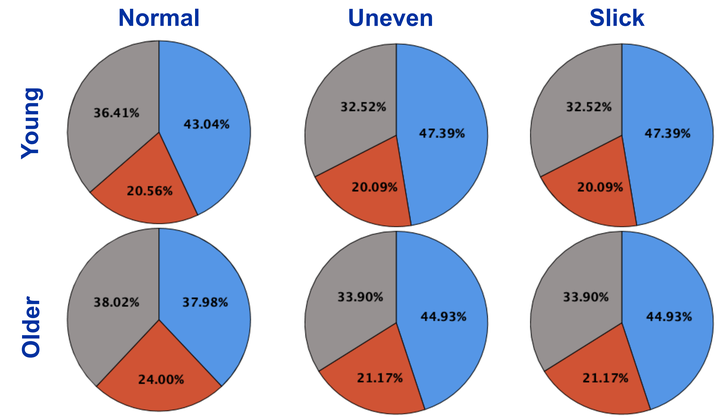



**Figure 4.** Hip (grey), knee (orange) and ankle (blue) relative effort for young and older adults on each surface (normal, uneven, and slick).

**KEY FINDINGS:**

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

2) On the challenging surfaces, particularly uneven, individuals produced more work from the hip and knee.

3) The ankle produce a larger percentage of work to ascend stairs without the challenging surface.

## CONCLUSION

Individuals *produce greater work from the larger proximal musculature of the hip and knee* to ascend stairs outfitted with challenging surfaces.

*Lower limb work production did not differ between young and older adults*, and challenging surfaces may impact all individuals similarly.

## ACKNOWLEDGEMENTS

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