BIOMECHANICS OF STAIR DESCENT IN OLDER ADULTS

[1]Victoria Hood, [1]Alexander Nicol,
[1]Bioengineering Unit, University of Strathclyde, Glasgow, UK;
email: victoria.hood@strath.ac.uk

INTRODUCTION

Negotiating stairs is one of the most difficult activities of daily living faced by older adults. Falls on stairs are one of the leading causes of accidental death amongst the elderly and the majority of these falls occur during stair descent [1,2].

Many researchers have studied the cardiovascular and musculoskeletal demands of stair ascent but there is little research on the biomechanics of stair descent. The purpose of this study was to investigate the biomechanics of stair descent in older adults.

METHODS

Fifteen healthy men in their 60's (mean age 66.2 years) and thirteen men in their 80's (mean age 82.2 years) underwent full body 3-D biomechanical assessment whilst ascending and descending a flight of four stairs. The second stair of the flight was instrumented using a Kistler forceplate and motion data were captured using an 8 camera Vicon motion analysis system at 120Hz. Subjects attempted 3 trials of stair ascent and descent using a handrail and 3 trials without use of a hand rail. Joint kinetics and kinematics were determined using Vicon BodyBuilder software. Data were normalized to 100 data points from foot contact on one step to foot contact on the step below and then averaged over the subject group.

RESULTS AND DISCUSSION

Men in their 80's descended the stairs significantly more slowly than the men in their 60's. There was no significant change in the amount of time spent in stance phase between the groups (Table 1). Use of a handrail had no significant impact on temporal step cycle parameters. Both groups were slower than younger subjects (mean age = 28.8 years) reported by Reiner et al. [3].

During the weight acceptance phase men in their 80's had a marked reduction in internal plantarflexion moment accompanied by a small increase in knee extensor moment (Figure 1). Throughout stance phase the knee extensor moment remained higher in the older men. This would indicate that the men in their 80's are using the knee extensors of the trailing leg to reduce the moment required by plantarflexors at initial contact. Overall this results in a more smooth moment generation pattern throughout stance. This pattern was observed both with and without use of a handrail.

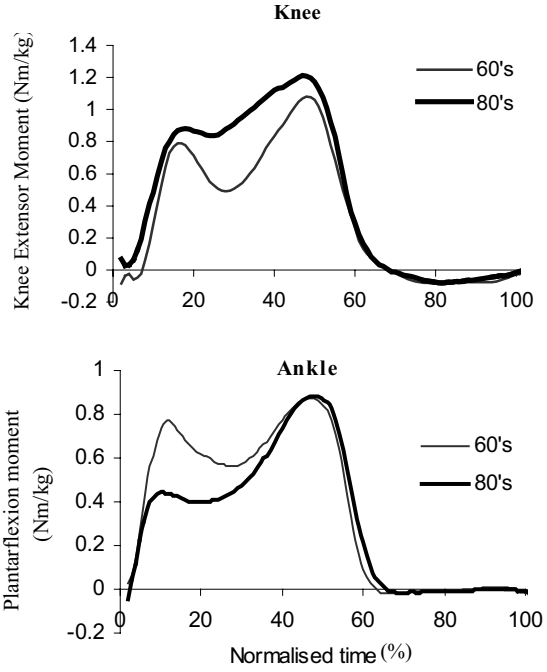

Figure 1: Saggital plane moments at the knee and ankle during stair descent averaged for men in their 60's and 80's

CONCLUSIONS

The strategy older men use to descend the stairs is one which results in a more consistent net moment in the ankle and knee extensors. The increased requirement of the knee extensors with age for stair descent may be a factor that contributes to difficulty performing this task.

REFERENCES

1. Tinetti M et al.. *N Engl J Med* **319**, 1701-1707, 1988
2. Startzell JK et al., *JAGS* **48,** 567-580, 2000
3. Reiner R et al., *Gait and Posture* **15,** 32-44, 2002

ACKNOWLEDGEMENTS

Supported by the Engineering and Physical Sciences Research Council Grant GR/R26856/01

Table 1: Averaged temporal step cycle parameters for stair descent without a rail

Age Group	Cycle duration (s) *	Cadence (steps/min) *	Stance phase (%)
60's	1.28 ± 0.21	48.5 ± 9.2	59.5 ± 3.0
80's	1.65 ± 0.38	38.4 ± 9.4	60.5 ± 2.8

* t-test $p < 0.05$