Introduction

Stability is known to decrease as we age, but currently we know very little about how the body’s balance system, the vestibular system, contributes to balance control in older adults, particularly while walking and climbing stairs.

• The vestibular system consists of two organs in the middle ear that detect changes in linear and angular accelerations of the head.
• When engaged in a balance task, skeletal muscles respond to the information coming from this system to maintain vertical orientation.
• Recent advancements in vestibular stimulation now allow us to assess the vestibular contribution to balance control in locomotion and stair negotiation.

The purpose of this study was to take the first step in understanding vestibular contribution to balance control during locomotion and stair negotiation, and how this changes with age.

Methods

Ten young adults and six older adults ascended and descended a nine-step staircase 78 times and walked on a treadmill for 10 minutes.
1. A small amplitude, random electric current was applied behind the ears to modulate the firing of the vestibular nerve.
2. Electromyography (EMG) was recorded from eight muscles of the leg spanning the ankle, knee, and hip joints: tibialis anterior, soleus, gastrocnemius, vastus medialis, rectus femoris, semimembranosus, biceps femoris, and gluteus medius.
3. Correlation (coherence) between the stimulus and the muscle activity was used to quantify the relationship between the stimulus and muscles.
4. Coherence was deemed significant if it exceeded a 95% confidence limit. Non-significant coherence has been set to zero.

Results

Vestibular influence was modulated across the step cycle in certain muscles, but not necessarily with the same profile as muscle’s activation.

In muscles where vestibular influence was seen in both populations, it was stronger and longer lasting in the older adults.

Vestibular influence was seen in more muscles in the aged population than in the young population.

Conclusions

These results suggest that as we age, we may rely more on vestibular signals in order to maintain balance during locomotion and stair negotiation.

Acknowledgements

Funding for this study was provided by a USU Undergraduate Research and Creative Opportunity Grant and this research was facilitated by Research Catalyst Grant.