Age-related Difference of Head Acceleration During Unexpected Perturbations

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BACKGROUND

- Older adults are exposed to higher risk of fall-related traumatic brain injury (TBI) [1].
- TBI results in increased hospitalization, morbidity and mortality rates in older adults [1].
- It can only be assumed that older adults have compromised head control during a fall since head stabilization in older adults has not been well documented [2].
- The limited knowledge on head acceleration during unexpected conditions may also factor into predicting head control strategies and fall risk.

PURPOSE

To investigate the age-related difference between the peak head acceleration during unexpected perturbations.

METHODS

The demographics of the participants in terms of age, BMI, and fall risk score are shown in Table 1.

Table 1. Demographic profile of two group populations

Groups	Young (N = 10)	Old (N = 10)
Age (yrs)	20.2±1.75	82.6±5.44
BMI (Kg/m^2)	20.4±2.37	27.2±4.93
Physiological Fall Risk Score	-0.189±0.57	0.738±0.69

- An accelerometer (Delsys, USA) was placed on the center of the forehead to record the linear head acceleration
- Participants completed three trails of unexpected translation of platform in the anterior and posterior directions using the Smart Equitest Research System (Neurocom, USA). A total of six translations were conducted in a random order.
- A custom Matlab code was used to detect the peak head acceleration that was filtered with a 4th order Butterworth filter with a cut-off frequency of 5 Hz
- SPSS Version 25 (IBM Inc., Chicago IL) was used for the data analysis. Normality was examined by Shapiro-Wilk test. Mann-Whitney U test was applied. Effect size (Cohen's d) was calculated.

RESULTS

The descriptive statistics of peak head accelerations in anteroposterior (AP) and mediolateral (ML) axes in different translations are shown in Table 2.

Table 2. The linear peak head acceleration, p value and effect size of mediolateral and anteroposterior directions of two translations in different age groups. * represents nearly significant p value. ** represents medium effect size

		Young	Old	P Value	Effect size
Anterior Translation	ML	1.24±0.15	1.19±0.10	0.739	0.089
	AP	1.23±0.21	1.32±0.20	0.165	0.460
Posterior Translation	ML	1.21±0.21	1.19±0.11	0.796	0.109
	AP	1.28±0.28	1.50±0.49	0.063 *	0.503 **

- No significant difference of linear peak head acceleration was found in both axes of anterior (AT) and posterior translation (PT) between age groups.
- Old adults demonstrated nearly significant larger peak head acceleration in the AP of PT than the young adults with a medium effect size

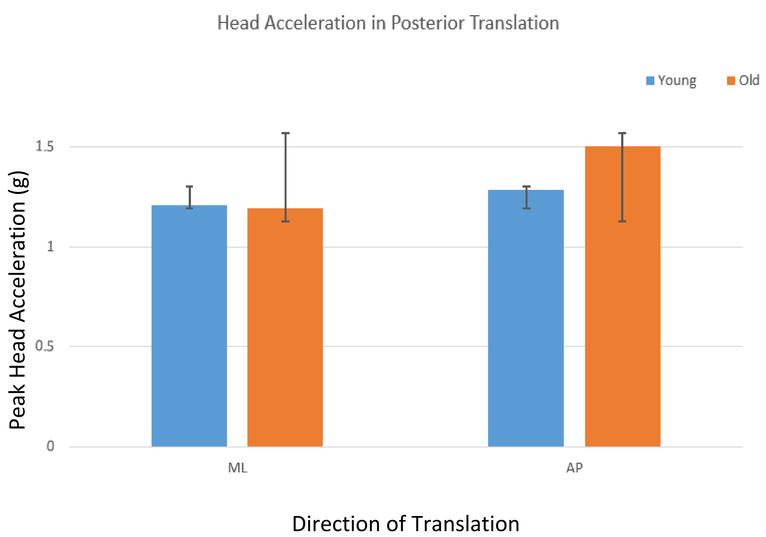

Figure 1. Peak head acceleration of AP and ML axes in the posterior translation among young and old participants.

DISCUSSIONS

- The main finding of the study was that older adults demonstrated higher linear head acceleration in the AP axis during the unexpected posterior perturbation.
- Our findings were not statistically significant, so caution is warranted in interpreting the results. Further research with a larger sample size would be needed to further validate the potential age-related difference of head control during unexpected perturbations.
- The medium effect size (0.503) hints that the greater linear head acceleration of AP axis during PT in the older adults is likely to be true.
- This study suggests that young and old adults are likely to use different head control strategies to counteract naturally occurring unexpected external perturbations such as slipping on ice or losing footing on stairs.
- In this study, the lack of age-related difference of head control in ML axis may have resulted from the nature of anteroposterior perturbations. Comprehensive head control during perturbations in multiple axes should be further explored.

CONCLUSION

Possible age-related differences in head acceleration in AP axis during posterior translations suggest different head control strategies between old and young to counteract unexpected perturbations. More evidence is needed to support this result.

REFERENCES

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