

Quantifying the links between age, vestibular function, and balance

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Both vestibular function and balance degrade with age, and balance degradation contributes to falls. Multiple causes contribute to both balance declines and falls. We are not aware of any comprehensive empirical investigations focused on the effect of aging on vestibular function and on the specific vestibular contributions to balance that mediate (i.e., explain a significant fraction of) the effect of age on balance. Our goals were to quantify age-effects on vestibular function, to determine if vestibular function mediates the effect of age on balance, and to quantify the fraction of any such statistically significant age-effect on balance. Vestibular thresholds for 5 motions (0.2 Hz roll tilt and 1 Hz roll tilt, yaw rotation, y-translation, and z-translation) were determined using standard methods with motion provided by a Moog 6DOF motion platform for 105 subjects. In a subset (N=99) of these subjects, balance was quantified as complete/incomplete on a standard Romberg foam balance test (the modified Romberg 4-condition test). Mediation analyses were performed to determine if any of the five vestibular thresholds we measured mediated the previously reported age-effect on balance. We report: (a) that vestibular thresholds for all 5 different motions increased with age above about 40 years of age (Bermúdez Rey et al, 2016), (b) that the probability of not completing the balance test depended only on roll tilt 0.2 Hz thresholds and not sex nor any of the other four threshold measures and that the chance of failing condition 4 (eyes-closed, on foam) depended significantly on both 0.2 Hz roll tilt thresholds ($p=0.006$) and age ($p=0.013$) (Karmali et al, 2017), and (c) 0.2 Hz roll tilt thresholds were found to significantly mediate the relationship between age and balance – explaining between 33% and 55% of the total age-effect on balance. These studies begin to describe the relationships between age, balance, and vestibular sensitivity. If these findings are confirmed by future studies, this may provide an opportunity to improve balance (and presumably reduce fall risk) via specific therapies tailored to improve vestibular function.

References:

- (1) Bermúdez Rey et al (2016). Frontiers in Neurology 7(162),
- (2) Karmali et al; (2017). Frontiers in Neurology 8(578).

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