Age-related differences in whole-body coordination and dynamic reaction time during voluntary postural movements

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The normal ageing process is associated with an overall decline in stability and ineffective control of the upper-body during standing and walking tasks. However, little is known about age-related changes in the coordination of whole-body postural responses under more dynamic and time-critical movement conditions. The aim of this study was to examine age-related changes in reaction time and the pattern of coordination between the COP and accelerations of the head and trunk during a dynamically challenging postural task.

Ten young $(24 \pm 5 \text{ yr})$, and ten healthy and fit, community-living older men $(75 \pm 2 \text{ yr})$ stood on a balance plate with 3D accelerometers fastened to the head and trunk. The task goal was to initiate voluntary postural sway in the AP or ML direction as quickly as possible following an auditory cue. The sway motion was initiated under static or dynamic conditions. Static reaction movements involved generating AP or ML sway from a standing still posture. Dynamic reaction movements involved an orthogonal switch of sway between AP and ML directions.

The results were that older subjects exhibited increased reaction time for the dynamic condition, meaning that older subjects reacted slower when switching the direction of sway between the AP and ML directions than young subjects. Older individuals additionally exhibited stronger inphase relations between the COP, trunk and head compared to the young during the postural responses.

Overall, older participants reacted slower, especially under more dynamic movement conditions that presented a greater challenge to the maintenance of postural stability. The stronger coupling between the COP, trunk and head in older subjects indicates that they adopted a more rigid posture than the young. This freezing of degrees of freedom in addition to the slower reaction time suggests that the elderly sacrificed speed of response to maintain an increased perception of postural stability. For the elderly, the loss of functional degrees of freedom through increasing body stiffness coupled with the slower response times would seem to be detrimental to maintaining optimal postural stability.