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Thesis Defense

Tactile somatosensation and postural control decline across the lifespan

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Master of Science in Kinesiology

Biomechanics and Motor Control Concentration

September 14th, 2021

11:30 AM

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Riley J. Horn. Tactile somatosensation and postural control decline across the lifespan

Department of Kinesiology, September 2021

Falling is a critical health concern affecting the aging population. An estimated 30% of adults over the age of 65 fall each year, contributing to $50 billion in annual fall-related medical costs in the United States. Fall prevention programs require effective fall risk assessment and targeted interventions which consider the underlying causes of loss of balance. Postural control is essential for maintaining balance. Sensory inputs provide valuable information regarding the position of the body in reference to the environment, gravity, and internal cues. Deficits in sensory inputs place constraints on the postural control system and can lead to falling. Notably, a critical component of sensory information is tactile somatosensation, which has been reported to account for as much as 70% of postural control. Tactile somatosensation can be assessed clinically; however, there are no established parameters for measuring tactile somatosensation in regard to postural control. Despite its importance to postural control, it remains unclear which modality, testing location, and degree of somatosensation loss is most indicative of postural control. The purpose of this study was three-fold: 1) to establish normative values of tactile somatosensation for typical adults across the lifespan, 2) to identify key somatosensory inputs for postural control and 3) to explore PST and VPT associated with postural control.

This study assessed 75 adults (aged 25-85) for postural control outcomes and tactile somatosensation thresholds. Postural control was assessed using the Sensory Organization Test (SOT) and the Motor Control Test (MCT). Tactile somatosensation thresholds were evaluated across 14 sites of the foot and ankle for pressure sensation threshold (PST) and vibration perception threshold (VPT). PST was assessed using a Semmes-Weinstein graded monofilament test kit. VPT was assessed using a hand-held biothesiometer.

Differences in sensitivity were apparent across the sites of the foot and ankle for both pressure and vibration sensation. A main effect of age group on tactile somatosensation was observed across all 14 sites for both PST and VPT ($p < .001$). Tactile somatosensation was significantly associated with the SOT at all 14 sites for PST ($r = -.27$ to $-.57$, $p < .05$) and VPT ($r = -.46$ to $-.56$, $p < .01$). Associations with the MCT were significant at 12 sites for PST ($r = 0.22$ to 0.43 $p < 0.05$) and all 14 sites for VPT ($r = .41$ to $-.47$, $p < .05$). VPT appeared to be more strongly associated with postural control outcomes than PST. A stepwise linear regression analysis identified key somatosensory inputs for postural control; VPT at the medial arch and PST at the medial arch explained 48.9% of the variance of SOT composite equilibrium score and PST at the plantar surface of the first toe and third toe and VPT at the plantar surface of the third toe and lateral arch explained 46.1% of the variance of MCT composite latency time. An exploratory investigation using receiver operating characteristics revealed modest predictive ability for these key somatosensory sites (area under the curve = .73 to .81, $p < .01$). The findings of this study may provide useful insight into the site-specific somatosensory thresholds which are most relevant for postural control. Further analysis should pair these key sites with existing clinical fall risk assessment in a population of prospective fallers to further investigate the potential for site-specific somatosensory thresholds to identify fall risk.