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The effect of gait speed on lateral balance control during walking in healthy elderly

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Abstract

The aim of this paper was to investigate the effect of speed dependency on lateral gait parameters. In 36 healthy elderly (mean age = 72.5 years, S.D. = 3.2 years), walking at four different self-administered speeds, mediolateral trunk acceleration and step width (SW), but not step-width variability (SWV), were found to have quadratic relations to gait speed. Normalizing for speed by curvilinear interpolation, and controlling for subject characteristics, disclosed smaller SW (adjusted $R^2 = 0.41$, $P < 0.001$), but larger SWV (adjusted $R^2 = 0.26$, $P = 0.01$) with increasing age in multiple regression models. These relations were camouflaged at preferred speed.

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1. Introduction

Balance problems are experienced by many old people [1]. Falls in elderly often occur during locomotion, and gait disorders are common risk factors for falls [2–4]. Identifying gait parameters possibly associated with balance control may therefore be a step towards understanding balance dysfunction in the elderly. While the vast majority of research on human gait has focused on movements in the anteroposterior direction [5], movements in the mediolateral (ML) direction may have particular importance for balance control [6–9].

Gait parameters are typically derived from movements of the lower limbs. The primary goal for lateral balance control, however, is to maintain center of mass (COM) within the lateral borders of the base of support [7]. Patla et al. [8] concluded that foot placements as well as trunk motion are control mechanisms for lateral balance control.

Winter [10,11] stressed the importance of acceleration of COM as a measure of balance control. COM acceleration can be derived from displacement data, but reliability of such procedures may be disputable, due to restrictions of the models in reproducing individual differences in body composition, and noise resulting from repeated differential calculations. An alternative method suggested in this study is directly measuring trunk acceleration (TA) of a reference point close to where COM is believed to be during standing and walking.

Several investigators have suggested step width (SW) to be a measure of balance control in gait [12,13], but investigations on SW in fallers and people with fear of falling are non-conclusive. The discursive point is whether elderly with a tendency to fall walk with a narrow base of support to minimize lateral instability [14], or with wider strides for safety [15]. No clear relation has been shown between SW and age [12,16], or between SW and gender [2,17].

One feature used to identify people at risk of falling is lateral gait unsteadiness [18] or step-width variability (SWV), measured as within-subject standard deviation (S_w) [19] or coefficient of variation (CV) [17,19,20]. Unsteadiness has been found to increase with age [17,21] and to be greater in fallers than non-fallers [13].

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