ABSTRACT FOR ESMAC 2024

Spatiotemporal parameters of older adults' outdoor walking on hilly and level terrains

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ABSTRACT

Introduction

Walking differs between indoor and outdoor conditions in older adults but is usually assessed on a level indoor surface. To understand how people adapt their walking to various environments, it is important to also study walking outdoors, including in hilly terrain. Walking can be assessed in terms of spatiotemporal parameters (stride, swing and stance duration, step length and velocity, and cadence), which are affected by age and environment. The aim of this study was to compare older adults' spatiotemporal parameters when walking on level, uphill, and downhill terrain outdoors.

Research Question

How do spatiotemporal walking parameters change when older adults walk outdoors on level terrain compared to uphill and downhill walking?

Methods

A healthy sample of older adults (n=35, mean age 76 (sd 4.9), 71% women) without chronic conditions that would influence walking, walked on a level sport track and on an uphill and downhill asphalt route at self-selected speed. Inertial measurement units (IMU) which included 3d-accelerometer, 3d-gyroscope, and 3d-magnetometer, were used to estimate spatiotemporal parameters (stride, swing and stance duration, step length and velocity, and cadence). Three IMUs were attached to the body of the participant: one on the lower back and one on each lateral shank. Spatiotemporal parameters were calculated based on initial contacts from the lower back IMU anterior-posterior acceleration signal [1,2] and toe-off was computed from the shank IMU sagittal angle velocity signal [3,4]. Step length was calculated assuming compass gait and using an inverted pendulum model combined with the lower back IMU vertical acceleration signal [1,2]. Repeated measurement ANOVA was used to estimate differences between spatiotemporal parameters and variability of spatiotemporal parameters (sd/mean*100%) for the level, uphill, and downhill conditions. Bonferroni correction was used in post hoc analysis.

Results

Statistically significant differences were found between the three terrains for all spatiotemporal parameters, and between variability of all spatiotemporal parameters except swing and stance duration. Walking was slower, steps were shorter, cadence lower and stride and swing durations longer on the level terrain and uphill compared to downhill. On the level terrain, cadence was

higher, and stride and stance duration were shorter compared to uphill. Cadence, stride duration, step length and velocity varied more in uphill compared to level terrain. Cadence and stride duration also varied more in uphill compared to downhill, and stride duration and step velocity varied more in downhill compared to level terrain.

Discussion

During outdoor walking, older adults exhibited differences in stride duration, cadence, step length and step velocity between level and downhill and between uphill and downhill conditions. Variability of these parameters was greatest when walking uphill. These results can be utilized when planning walking exercise or rehabilitation interventions for older adults.

References

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