THE EFFECT OF A COGNITIVE INHIBITION TASK ON GAIT PERFORMANCE DURING SELF-PACED TREADMILL WALKING

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INTRODUCTION

Gait analysis can be used to predict health status in the elderly (1). Gait is no longer postulated as a totally automated motor task. It requires multiple executive function processes to utilise safe and efficient gait (2). With advanced age, executive function declines, which is linked to an increase in gait variability and fall-risk. Dual-task paradigms have been introduced to explore the automaticity of gait by challenging inhibition and/or attention (i.e. executive function). The utility of using dual-tasking has become more evident (2). However, the great variability of the dual-tasking paradigms limits its use in clinical gait assessment. There is also a lack of evidence for the consistency of dual-task effects upon gait performance. This may be due to the limited number of consecutive strides included during over-ground walking and effects of treadmill's speed on gait patterns (3).

The aim of this study was, therefore, to explore the effect of an inhibition response task on gait performance during self-paced treadmill walking and the consistency of gait measurements between days.

METHODS

Twenty-three healthy male subjects (mean age: 34.56 + 5.12 years) walked on a GRAIL system (Gait Real-time Analysis Interactive Lab, Motek Medical B.V.) at two different sessions, 5 ± 3 days apart. The GRAIL system consists of an instrumented dual-belt treadmill with a twelve-camera Vicon capture system. The self-paced mode was used with virtual-endless scene. Each subject walked randomly under two conditions: 1) Free walking (FR); 2) walking while performing a Colour Stroop test (read the colour not the word) (DT). The average values of temporal-spatial gait parameters (speed, step length, stride time and step width) and variability across 100 consecutive gait cycles were computed. A repeated measures ANOVA was used to explore the effect of inhibition response tasks on these outcomes. The level of statistical significance was set at $p<0.05$.

RESULTS

Descriptive statistics for average and variability values of temporal-spatial gait parameter for each walking condition are presented in Table 1. In the first day, there was a significant effect of dual-task on both average mean of step length and width. In the second day, there was significant effect on all average gait parameters, except step width. On gait variability, there was no significant difference in all gait parameters in two days. The number of correct Stroop task answer showed significant improvement in second session.

DISCUSSION AND CONCLUSIONS

The present findings showed that the dual-task significantly altered subjects' gait stability during their first visit, as reflected in the mean values of step-width. This was not the case during the second visit. However, due to the significant improvement in correctly reading the 'colour' of presented words during the second visit, walking speed, step-length, and stride-time have been significantly increased during the dual-tasking walking. This may lead to suggest that the alterations in the mean values might be associated with improvements in cognitive process. This has also been reflected by the fact that there was no effect of dual-tasking on gait variabilities. Alterations in gait variability have been related to executive function impairments (4). Taken together, this supports results obtained from healthy subjects. In terms of consistency, the results indicate that the GRAIL system provided consistent gait spatial-temporal parameters between days across walking conditions. Future research should explore the utility of our dual-task paradigm in patients with neurological conditions.

Table 1: Descriptive statistics (means and standard deviations (sd)) of gait parameters during two walking conditions: FR (single walking task), DT (walking while performing Stroop task), and p= p value.

AVERAGE MEAN OF TEMPORAL SPATIAL PARAMETERS								
	Day 1			Day 2			Between Days	
	FR (Mean± sd)	**DT (Mean± sd)**	**p**	**FR (Mean± sd)**	**DT (Mean± sd)**	**p**	**p_{FR}**	**p_{DT}**
Walking speed (m/s)	1.4548(0.153)	1.503 (0.138)	0.068	1.467 (0.171)	1.530 (0.158)	0.015	0.424	0.115
Step-length (m)	0.742 (0.062)	0.769(0.0936)	0.043	0.742 (0.764)	0.764 (0.061)	0.013	0.996	0.645
Step-width (m)	0.095 (0.030)	0.101 (0.031)	0.027	0.096 (0.027)	0.098 (0.028)	0.269	0.772	0.452
Stride-time (s)	1.030 (0.073)	1.021 (0.730)	0.522	1.018 (0.076)	1.003 (0.069)	0.039	0.114	0.118
VARIABILITY MEAN OF TEMPORAL SPATIAL PARAMETERS								
Walking speed (m/s)	0.129 (0.019)	0.135 (0.024)	0.050	0.128 (0.020)	0.131 (0.023)	0.171	0.874	0.298
Step-length (m)	0.025 (0.023)	0.080 (0.248)	0.306	0.019 (0.006)	0.019 (0.010)	0.734	0.210	0.249
Step-width (m)	0.021 (0.005)	0.021 (0.006)	0.664	0.020 (0.005)	0.021 (0.006)	0.147	0.282	0.062
Stride-time (s)	0.021 (0.016)	0.060 (0.156)	0.264	0.017 (0.008)	0.016 (0.008)	0.442	0.159	0.200
Percentage of correct performance on Stroop task during walking								
Correct answer percentage in %	93 (± 0.14)			96.5 (± 0.06)			p_{Stroop}=0.011	

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