Dual-task effects on gait adaptability and cognitive performance in healthy adults

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Abstract

Introduction: Activities of daily living frequently require simultaneous performance of multiple tasks, demanding divided attention and resulting in cognitive-motor interference [1]. Falls are often caused by a combination of external and internal factors, as well as reduced attention during walking, particularly when tasks are performed concurrently [2]. Limited gait adaptability, defined as the ability to modify the walking pattern in response to environmental and task demands, represents an important risk factor for falls. Most previous studies have focused on straight-line walking at a constant speed [3], which does not adequately reflect the complexity of gait in everyday life. The aim of this study was to investigate dual-task effects on gait adaptability and cognitive performance in healthy adults.

Methods: This cross-sectional study was conducted in two separate phases using convenience sampling. Thirty participants were included in the first phase and 31 in the second, with 17 individuals participating in both phases. Participants were 30-61 years old. Gait analysis at preferred walking speed was performed using instrumented treadmill C-Mill. Participants completed three primary walking conditions: straight-line walking, obstacle crossing, and walking with unpredictable accelerations and decelerations. These conditions were performed without and with five added tasks: a verbal fluency task, serial subtraction by threes, using a walking cane, carrying a full glass of water and using a rollator walker. Spatiotemporal gait parameters, performance outcomes (obstacle crossing success and performance during accelerated/decelerated walking) and dual task costs were analyzed in two sets of comparisons: (1) each dual-task versus the corresponding single-task walking condition, (2) the effects of dual-task conditions across different walking tasks. In addition, cognitive task performance was analyzed and compared during walking versus seating. The study was approved by the institutional ethics committee (No. 035-1/2021-32/4.3).

Results: During straight-line walking, all added tasks affected spatiotemporal gait parameters, with the greatest impact observed when walking with a cane. During obstacle crossing, cane use significantly reduced cadence, whereas none of the added tasks affected obstacle-crossing success. While walking with accelerations and decelerations, added tasks did not influence cadence, however, they significantly reduced performance success compared to walking without an added task. Analysis of participants who took part in both study phases (n = 17) showed that obstacle crossing without an added task, with verbal fluency, or with a cane use resulted in the lowest cadence compared with straight-line walking and walking with accelerations/decelerations under the same experimental conditions. Performance of the verbal fluency task did not differ between conditions, whereas performance of the serial subtraction was significantly worse during walking compared to seating, indicating the presence of cognitive–motor interference in walking. All reported differences were statistically significant ($p < 0.05$).

Conclusions: All added tasks altered spatiotemporal gait parameters during straight-line walking, while a cane use specifically reduced cadence during obstacle crossing. While walking with accelerations and decelerations, added tasks impaired performance success without affecting cadence. Serial subtraction performance demonstrating cognitive–motor interference in walking compared to seating position. The impact of added tasks depends on type of walking task and the nature of the secondary task, providing a basis for future studies and for the clinical assessment of gait stability in populations at increased risk of falls.

Keywords

dual task, gait adaptability, healthy adults

References

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