LOWER LIMB MUSCLE FATIGUE AFFECTS HUMAN GAIT AND WORKING MEMORY PERFORMANCE UNDER SINGLE AND DUAL-TASK IN YOUNG ADULTS

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INTRODUCTION

- Walking while performing a cognitive task may occur concurrently with muscle fatigue, especially towards the end of active jobs.
- According to the 2014 Liberty Mutual Workplace Safety Index, falls on the same level ranked second of leading cause of all workplace injuries with direct costs of $9.19 billion and accounted for 15.4 percent of the total workplace injury burden [1].
- Although previous research has demonstrated independent effect of fatigue or working memory tasks on walking [2], their interaction is rarely considered.
- However, daily living performance necessitates both adequate motor control and cognitive function, at times simultaneously and under fatigued conditions.

Purpose:

- The purpose of this study was to examine changes in gait characteristics and working memory performance of healthy young adults when lower extremity muscles are fatigued, under single- and dual-task.

METHODS

- Subject inclusion criteria: 1) 18-40 years old, 2) able to walk over ground and cross over (single-step) an obstacle without an assistive device, and 3) have normal hearing.

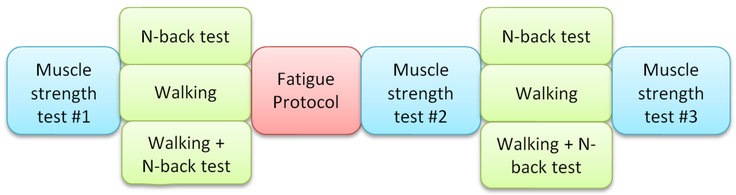

Figure 1. Outline of the experimental protocol.

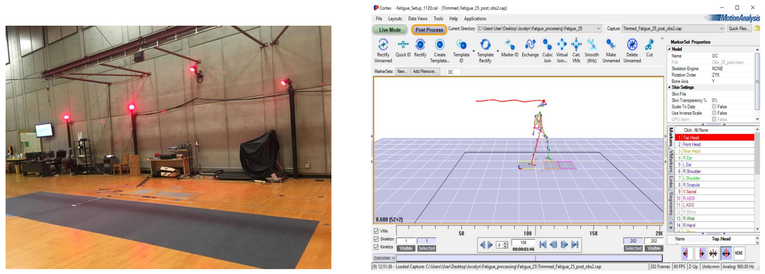

Figure 2. The Motion Analysis Laboratory (left) and a screenshot of the Cortex software processing raw data (right).

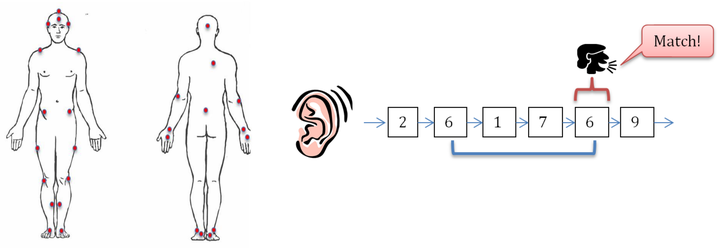

Figure 3. Placement of reflective markers (left) and auditory N-back test schematic (right).

METHODS

Dependent variables:

- Gait Characteristics:

  Stride Width, Stride Length, Gait Velocity, Peak Forward Velocity

- Working Memory Performance:

  N-Back Test Accuracy

Analysis: Data were analyzed by 2X2 ANOVA with repeated measures (condition x time).

RESULTS

Characteristic	Subjects
Sex	12 male / 11 female
Age (years)	20.7 (± 1.3)
Height (cm)	171.1 (± 6.8)
Weight (kg)	68.6 (± 9.5)

Table 1: Study subject descriptive information

Fatigue Effect: Stride Width

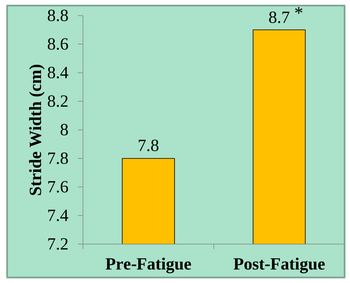

Figure 4: Stride width was significantly increased from pre-fatigue to post-fatigue, *p = .005.

Single vs. Dual-Task Effect: Stride Length, Gait Velocity, Peak Forward Velocity

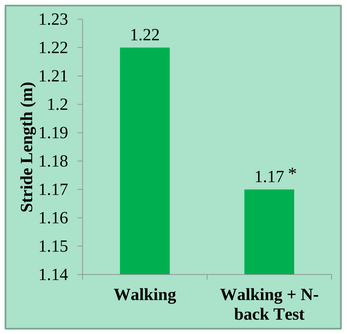

Figure 5. Stride length significantly decreased stride length during dual-task, *p < .001.

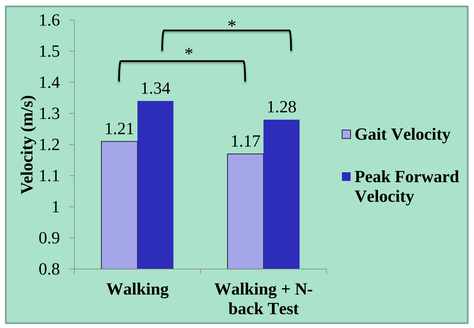

Figure 6. Gait velocity and peak forward velocity both significantly increased during dual-task, *p < .001.

RESULTS

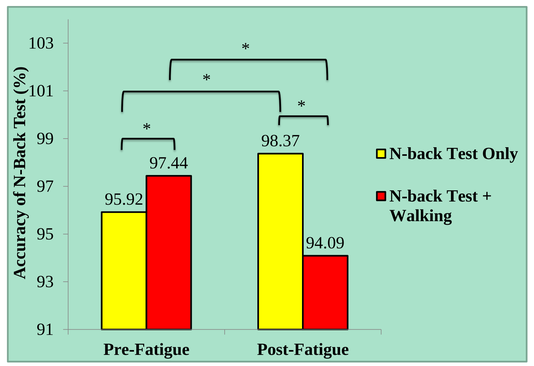

Figure 5: This graph illustrates the accuracy of the N-back test across conditions (single- and dual-task), pre- and post-fatigue, * p < 0.05.

DISCUSSION

- **Attention** has a capacity [3] and must be allocated effectively in order to carry out daily activities; when a **dual-task** occurs, attention is divided according to task difficulty or priority.
- Healthy young adults counting backwards while walking have exhibited significant decreases in **stride velocity** [4].
- Healthy young adults engaging in cognitive tasks showed *reduced stability* during walking [5]. Furthermore, difficult *cognitive tasks suffer* in the context of walking [6].
- Previous studies have found healthy young adults who were *fatigued* exhibited increased **step width** [7]. *Fatigue* has been shown to increase the difficulty of motor control through destabilizing effects (increased step width and speed) [8].
- It has been suggested a decreased **step width**, among other gait characteristic changes, is a stabilizing adaptation in response to the fear of falling [9].
- Light and moderate aerobic exercise has been shown to improve cognitive function in healthy young adults. This might explain why **N-back test accuracy** improved when subjects were *fatigued* [10].
- Muscular fatigue from movement throughout the day may increase the risk of falls. Engaging in working memory tasks may detract from motor control.

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ACKNOWLEDGEMENTS

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