EFFECTS OF LOWER EXTREMITY MUSCLE FATIGUE ON DUAL-TASK OBSTACLE-CROSSING IN ACTIVE AND INACTIVE YOUNG ADULTS

Smith, S, Chen, S-H, Taylor, J, and Chou, L-S
Department of Human Physiology, University of Oregon, OR, USA
email: chou@uoregon.edu; web: http://choulab.uoregon.edu

INTRODUCTION
Fatigue in the lower limbs has been shown to alter gait characteristics during both free and adaptive walking, such as obstacle crossing [1,2]. Fall risk has been shown to increase when attention is divided between different tasks [3], which occurs often for many people. Additionally, physical activity level has also been shown to influence gait characteristics [4]. Despite previous studies showing the effect on walking of fatigue in addition to a cognitive task being performed [5], no study, to our knowledge, has investigated how fatigue influences dual-task obstacle crossing in physically active and inactive adults. Therefore, the purpose of this study was to examine the differences in gait between active and inactive individuals during a dual-task obstacle crossing environment after lower limb muscle fatigue.

METHODS
Twenty-four healthy young adults were classified into active and inactive groups using the habitual physical activity questionnaire (HPA), where subjects were classified above (active, 7.6 ± 0.4, 8 males and 5 females, 21.4 ± 2.9 yrs.) or below (inactive, 6.3 ± 0.6, 6 males and 5 females, 20.8 ± 1.3 yrs.) the median score of 7.25. The only significant difference between the groups were the HPA scores. Each participant performed three tasks before and after a muscle fatigue protocol in random order: 1) Crossing an obstacle at a height of 10% body height while walking (OC), 2) Sitting and performing a 3-back test, where participants listened to a series of digits over a speaker and were to respond, “yes” when a digit was heard that was pronounced three numbers back (Nback), 3) Walking while also performing 1 and 2.

The fatigue protocol consisted of a 30-minute sit-to-stand task at a pace of 0.5 Hz. Muscles were considered fatigued when the 30-minute time limit was reached or when the movement frequency of the participant slowed to less than 0.5 Hz. Maximal voluntary isometric strength of knee extensors and flexors was assessed using a dynamometer prior to fatigue, immediately after fatigue, and after entire study protocol was completed.

29 retro-reflective markers and a 10-camera motion analysis system captured whole body motion data, where body CoM was defined as the weighted sum of 13 body segments. The average forward CoM velocity was considered the gait speed. Vertical distance between the obstacle and toe marker of crossing foot was defined as toe-obstacle clearance (TC). Horizontal distance between the obstacle and toe or heel marker was defined as foot placement (FP).

A two-way mixed effect ANOVA was used to examine effects of fatigue (pre- and post-fatigue) and activity level (active and inactive). ANOVA was used at both single and dual task gait conditions. Alpha was set at 0.05.

RESULTS AND DISCUSSION
On average, knee extensor strength dropped 22.8% due to fatigue, then recovered to 14.1% reduction. No fatigue data were significantly different between the two groups. Additionally, dual task environment yielded no significant main effects or interactions for the different groups.

Figure 1. Average leading and trailing foot placements (±SD) before and after fatigue protocol for active and inactive groups in single task environment. *p < .05

In the single task environment, gait speed significantly increased from pre- to post-fatigue in each group, but was not dependent upon the group. FP of both leading and trailing feet showed significant interactions. Post-fatigue, the active group placed their foot closer to the obstacle after crossing than pre-fatigue. Before fatigue, the inactive group placed their foot closer to the obstacle after crossing than the active group (Figure 1). Before crossing, the active group placed their foot farther away from the obstacle, post-fatigue than their prefatigued condition. Prior to fatigue, the inactive group placed their foot farther away from the obstacle before crossing compared to the active group (Figure 1).

CONCLUSIONS
Findings from this study indicated that the induced lower limb muscle fatigue in both active and inactive participants affected foot placements when crossing an object in single task environments depending on the group.

REFERENCES