EFFECT OF RESPIRATION DYNAMICS ON POSTURAL CONTROL FOLLOWING A 5K RUN

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INTRODUCTION: Research has shown postural control during upright stance can be diminished for up to twenty minutes following aerobic exercise of different types, intensities, and durations (Lepers et al., 1997; Nagy et al., 2002). Researchers have posited that this is caused by neuromuscular changes associated with aerobic exercise and fatigue such as the reduced excitability and central drive to peripheral muscles (Lepers et al., 2002), vestibular desensitization (Lepers et al., 1997), and peripheral somatosensory desensitization (Lepers et al., 1997). However, no research has measured or attempted to control for the influence that changes in respiration dynamics (e.g., rate and volume) alone might have on postural sway. The aim of the current study was to examine these effects in order decipher whether changes to postural control following intense aerobic exercise (a 5-kilometer run performed with maximal effort) can be attributed to effects of exercise and fatigue or simply changes in respiration.

METHODS: Eighteen (M=9, F=9) healthy college-aged students underwent two experimental sessions. In the first session participants completed a 5k treadmill run (average run time = 28:00 min). Center of Pressure (COP) and respiration rate/volume were recorded prior to the run (resting), immediately after completing the run (0-min.) and at 2, 5, and 10 minutes post-run while participants stood bipedal on a forceplate for trials of 30 seconds (COP data sampled at 100Hz). In a follow-up session (one week after the initial session) participants returned and were asked to replicate the exercise-induced respiration dynamics obtained during the first session while COP was recorded for trials of similar durations. A metronome was used to help participants replicate their respiratory rates and feedback was provided by experimenters to aid in replicating respiratory volume. Anterior-Posterior (AP) and Medial-Lateral(ML) COP data were analyzed with Sample Entropy (SampEn – a measure of sway complexity) (Richman & Moornman, 2000), Root Mean Square Amplitude (RMS – a measure of average sway 'area'), and Path Length (a measure of overall 'amount' of sway). Inferential analyses were conducted using a set of 2(Condition; 5k run vs. Replicated) x 5 (Time; resting, 0, 2, 5, and 10-min) repeated measures ANOVAs for each dependent variable followed by a set of planned contrasts for all Condition and Time pairings (α=0.02).

RESULTS & DISCUSSION: Following the 5k run both respiration rate and volume were increased compared to resting levels up to 10-min. post run. No significant differences in respiration rate and volume were found between the first and follow-up sessions for any time period. This later finding indicates that participants successfully replicated their respiration dynamics in the follow-up session. Results from analysis of COP data revealed that increases in respiration rate and volume alone caused changes to postural sway. The measures and time periods where changes occurred are indicated in Figure 1 (*).These changes included increases in the amount (increased Path Length), but decreases in the complexity (decreased SampEn) of sway, both of which can be interpreted to reflect decreased postural control. However, results showed that changes in respiration dynamics alone could not account for all the changes that occur to postural sway following intense aerobic exercise. Instead, following the 5k run

participants showed further decreases in sway complexity, and increases in the 'amount' and 'area' of sway, as see in Figure 1 (^).

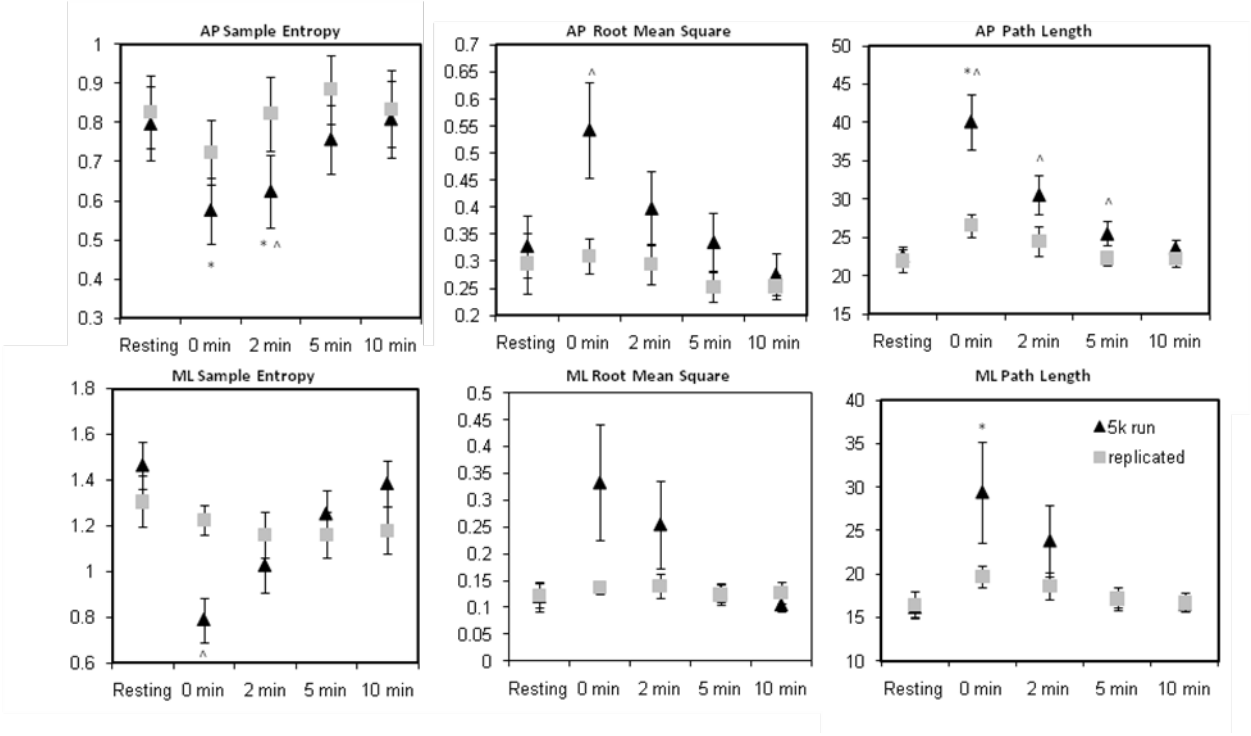

Figure 1. Mean (±SE) for each COP postural sway measure for 5k-run and Replicated conditions.
* indicates significance ($p \leq 0.02$) between Replicated and Resting values.
^ indicates significance ($p \leq 0.02$) between Replicated and 5k-run values.

CONCLUSION: These findings indicate that postural control may be compromised following intense aerobic exercise for a brief period of time (less than 5-min), but that these effects cannot be solely accounted for by changes in respiration leaving open the possibility that other neuromuscular changes associated with exercise and fatigue (e.g., vestibular desensitization) may negatively affect postural control. Although more work is needed to reveal exactly what these changes are and how they specifically effect postural control. This study may be of practical importance for those who engage in tactical precision activities following long or intense bouts of aerobic exercise (e.g., target shooting for biathletes, law enforcement agents, military personnel engaged, etc.) since our results show that postural control may be diminished by aerobic exercise in ways above and beyond that which can be attributed solely to respiration.

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