

Evaluation of cardiorespiratory responses during exercise challenge affords insights into Gulf War Illness

*Michael J. Falvo (Michael.falvo@va.gov; 201-414-8270)^{1,2}, Jacob B. Lindheimer^{3,4}, Aaron Stegner^{3,4}, Glenn R. Wylie^{1,5}, Thomas Alexander¹, Matthew Watson¹, Jacquelyn C. Klein-Adams¹, Nick Gretzon^{3,4}, Dane B. Cook^{3,4}

¹War Related Illness and Injury Study Center, Department of Veterans Affairs New Jersey Health Care System, East Orange, NJ

²New Jersey Medical School, Rutgers Biomedical and Health Sciences, Newark, NJ

³William S. Middleton Memorial Veterans Hospital, Madison, WI

⁴Department of Kinesiology, University of Wisconsin-Madison, Madison, WI

⁵Rocco Ortenzo Neuroimaging Center, Kessler Foundation, West Orange, NJ

VA Award #: This project is supported by Award Number I01 CX001329 from the United States (U.S.) Department of Veterans Affairs (VA) Clinical Sciences Research and Development (CSR&D) Service.

Research Topic: Pathobiology/Pathophysiology

Purpose: Many Gulf War Veteran (GV) investigators have incorporated exercise challenge into their research designs to compare physiological, biochemical, and/or behavioral responses before and after an acute bout of exercise. Although the utility of exercise challenge is clear, the cardiorespiratory features of this exercise challenge are frequently overlooked and may provide unique insight into underlying pathobiology of GVs with Gulf War Illness (GWI). The purpose of this preliminary analysis of an on-going investigation is to compare cardiorespiratory responses in GVs with (GWI+) and without GWI (GWI-).

Methods: Seventy-four GVs (GWI+, n = 42 [37 male]; GWI-, n = 32 [30 male]) volunteered to complete a 30-min bout of cycling at an intensity of 70% of heart rate reserve. Pulmonary gas-exchange and ventilation were measured breath-by-breath and heart rate was measured continuously via electrocardiography. Primary variables of interest included ventilatory efficiency (ventilatory equivalents to carbon dioxide and oxygen: $\dot{V}E/\dot{V}CO_2$, $\dot{V}E/\dot{V}O_2$), breathing patterns (tidal volume, V_T ; respiratory frequency f_R) and work rate (Watts) obtained during steady-state cycling. Differences between groups (GWI+, GWI-) were compared using the Mann-Whitney U test and effect sizes (Eta squared; η^2) were computed for pairwise comparisons.

Results: In comparison to GVs without GWI, GVs with GWI+ cycled at a lower work rates (GWI+ vs. GWI-; 77.7±22.2 vs. 97.5±32.2 Watts, $p = 0.001$, $\eta^2 = 0.15$), had less efficient ventilation ($\dot{V}E/\dot{V}CO_2$; 29.4±4.5 vs. 27.3±4.0, $p = 0.050$, $\eta^2 = 0.05$); $\dot{V}E/\dot{V}O_2$; 30.6±4.5 vs. 28.3±4.1, $p = 0.037$, $\eta^2 = 0.06$), lower V_T (1.8±0.4 vs. 2.2±0.5 L, $p = 0.010$, $\eta^2 = 0.09$), but similar f_R (26.8±5.1 vs. 25.6±4.7 breaths·min⁻¹, $p = 0.25$, $\eta^2 = 0.02$).

Conclusions: Despite cycling at similar heart rate intensities, there are distinct differences between GVs with and without GWI during exercise. These differences may provide insight into the cardiorespiratory health of the study sample and facilitate the interpretation of physiological, biochemical, and/or behavioral responses when assessed before and after an exercise stressor.