Effect of Particulate Matter Air Pollution on Vascular Function in Chronic Obstructive Pulmonary Disease

PRINCIPAL INVESTIGATOR: Russell S. Richardson, Ph.D.
              Professor: Department of Internal Medicine, Division of Geriatrics
              Professor: Department of Exercise and Sport Science

CO-INVESTIGATOR: Jayson R. Gifford, M.S.
              Department of Exercise and Sport Science

CO-INVESTIGATOR: Ash Nelson, M.D. Department of Internal Medicine, Division of Respiratory, Critical Care and Occupational Pulmonary Medicine

ABSTRACT

INTRODUCTION: Patients with chronic obstructive pulmonary disease (COPD) exhibit debilitating vascular function and increased cardiovascular disease risk\(^1\). Exposure to fine particulate matter (PM) air pollution, typical of the Salt Lake valley during wintertime inversions, is known to decrease vascular function and increase cardiovascular risk, likely through pollution-induced increases in inflammation and oxidative stress\(^2\). However, surprisingly, very little is known about the vascular consequences and potential mechanisms of ambient PM pollution specific to patients with COPD, a population recognized to have a vulnerable vascular system even when breathing clean air. Therefore, the aim of this study is to utilize Salt Lake City’s wintertime inversion as a “naturally” occurring intervention to 1.) determine if elevated PM pollution adversely affects the vascular function of patients with COPD 2.) determine if elevated PM pollution increases inflammation and oxidative stress in patients with COPD, and 3.) determine if pollution-induced changes in vascular function are associated with changes in levels of inflammation and oxidative stress in patients with COPD.

METHODS: Indices of vascular function (flow mediated dilation, passive limb movement, handgrip exercise, and pulse wave velocity) will be assessed in 10 patients with moderate-to-severe COPD on two occasions: once after 24+ hours of exposure to clean ambient air (PM\(_{2.5}\)<10 µg/m\(^3\)) and once after 24+ hours of exposure to wintertime inversion (PM\(_{2.5}\)>40.0 µg/m\(^3\)). To determine the role of inflammation and oxidative stress in mediating alterations in vascular function, indices of both will also be assessed on each occasion. ANTICIPATED RESULTS: Given the vulnerable nature of the vascular system in patients with COPD we hypothesize that exposure to high levels of PM pollution will result in attenuated vascular function and that this attenuation will be associated with increased levels of inflammation and oxidative stress. IMPLICATIONS: As our measures of vascular function are associated with overall cardiovascular disease risk\(^3\) this study will help determine if patients with COPD are at increased risk for cardiovascular events during wintertime inversions. Furthermore, understanding whether inflammation and oxidative stress are elevated under these conditions may lead to prophylactic treatments to minimize the health threat that PM pollution may pose to patients with COPD.