

Grant AFC719-53: Ergonomic and Aerosol Stressors and Their Interaction in Mining Environments

Organization and Principal Investigator: University of Cincinnati (Kermit Davis)

Focus Area: Injury & Disease Exposure & Risk Factors

Priority Area: Identification of Mining Jobs and Operations with High Rates of Work-Related Musculoskeletal Disorders (WMSD)

Problem Statement and Research Approach: Traditional workplace hazard characterization approaches investigate ergonomic and aerosols in the mines as separate hazardous exposures. However, we hypothesize that the inhalation of metal and non-metal aerosols in mines are directly impacted by the posture of the body or the ergonomics of the person. Poor working postures and heavy exertion would have a direct impact on the inhalation of aerosols for the exposed miner. Thus, jobs with poor ergonomics may not only influence the WMSDs but also increase the risk of chronic airway conditions such as asthma and COPD when exposed to various aerosols in the mine. It is important to understand the interplay of these hazards since control strategies that affect ergonomic risks may modulate aerosol risks, and vice versa. By evaluating both hazards and their interactions, information may be available to minimize the overall risk profile for mining tasks.

In order to provide a comprehensive investigation of the interactive and synergistic relationship of ergonomic and aerosol factors, a three phase study has been designed. Phase I will identify the risky tasks with respect to poor ergonomics and aerosol exposures in different mines. These sentinel tasks will be prioritized and selected as the tasks to be simulated in the laboratory (Phase II). The laboratory study will investigate the trunk kinematics, muscle load, and respiration effort when performing the sentinel tasks. Based on these assessments and well-established semi-empirical models, the expected aerosol load will be estimated. The final phase (Phase III) will be in the mines where we will measure actual aerosol and ergonomic load for miners while performing real tasks. The Phase III study will also assess the actual risk exposures for the miners being observed. Thus, the study design is a series of cross-sectional investigations of the ergonomic and aerosol exposures that will lead to insight about the interactions of the two stressors.

Specific Aims: The main hypothesis that will be tested in the proposed study is the following: More adverse postures and exertional stress increase exposure to musculoskeletal and aerosol stressors. The specific aims are:

- Characterize the task portfolio of active mining operations to develop a list of sentinel tasks that represent the greatest ergonomic and aerosol exposure hazards.
- Simulate in the laboratory sentinel tasks to develop a sensitivity analysis evaluating the impacts of ergonomic and aerosol related stresses on total worker health risk.
- Validate in the field for selected tasks to measure ergonomic and aerosol exposures in specific mines.