

Multiple Organ Injury in Mice Exposed to Ambient Particulate Matter in a Real-World Inhalation System in Shijiazhuang, China

Wen Chen^{1*}, Daochuan Li¹, Rong Zhang², Rui Chen³ and Yuxin Zheng⁴

¹Department of Toxicology, School of Public Health, Sun Yat-Sen University, China

²Department of Toxicology, School of Public Health, Hebei Medical University, China

³School of Public Health, Southeast University, China

⁴School of Public Health, Qingdao University, China

The development of a rodent ambient particulate matter (PM) inhalation system is critical for drawing causal inferences between PM exposure and the onset of human diseases. In this study, we constructed a real-world PM exposure system to investigate multi-organ injury and the reversibility of the impairments in C57BL/6J male mice exposed to PM with a duration of up to three months in Shijiazhuang, a city with the highest PM_{2.5} concentration in China. This unique exposure system provided an optimal scenario for round-the-clock PM exposure absent a change in the physicochemical properties of PM and minimized the disturbance to the mice habitat. The mean concentration of PM_{2.5} in the exposure chambers was 89.95, 79.98 and 87.87 μg/m³ at three different time points, respectively: weeks 1–3, week 1–6 and week 1–12. The injury in multiple organs, including lung, brain, heart, testis and intestine was profound and was evident by the significant pathological and functional alterations. Pulmonary pathological examination revealed severe interstitial inflammatory and alveolar hemorrhage throughout the exposure, which was in line with the reduced lung function and the increased cytokine excretion in bronchoalveolar lavage fluid and blood plasma. Notably, the PM-mediated inflammatory response in different systems was correlated with the severity of the injury and the attenuation of pulmonary lesions in the recovery group. Thus, the PM_{2.5}-induced inflammatory response, the chemical components-induced cytotoxicity, genetic damage and oxidative stress might be implicated in the impairment of multiple murine organs. These findings revealed the severity, sensitivity and reversibility of multi-organ injury in response to a real-world PM exposure.