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## Pulmonary and Systemic Immune Response to Chronic Lunar Dust Inhalation

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Topic of Interest: Preparations for long-duration human spaceflight missions, including Simulation of Lunar/Mars habitats

### ABSTRACT

**Background:** Due to millennia of meteorite impact with virtually no erosive effects, the surface of the Moon is covered by a layer of ultra-fine, reactive Lunar dust. Very little is known regarding the toxicity of Lunar dust on human physiology. Given the size and electrostatic characteristics of Lunar dust, countermeasures to ensure non-exposure of astronauts will be difficult. To ensure astronaut safety during any future prolonged Lunar missions, it is necessary to establish the effect of chronic pulmonary Lunar dust exposure on all physiological systems.

**Methods:** This study assessed the toxicity of airborne lunar dust exposure in rats on pulmonary and system immune system parameters. Rats were exposed to 0, 20.8, or 60.8 mg/m<sup>3</sup> of lunar dust (6h/d; 5d/wk) for up to 13 weeks. Sacrifices occurred after exposure durations of 1day, 7 days, 4 weeks and 13 weeks post-exposure, when both blood and lung lavage fluid were collected for analysis. Lavage and blood assays included leukocyte distribution by flow cytometry, electron/fluorescent microscopy, and cytokine concentration. Cytokine production profiles following mitogenic stimulation were performed on whole blood only.

**Results:** Untreated lavage fluid was comprised primarily of pulmonary macrophages. Lunar dust inhalation resulted in an influx of neutrophils and lymphocytes. Although the percentage of lymphocytes increased, the T cell CD4:CD8 ratio was unchanged. Cytokine analysis of the lavage fluid showed increased levels of IL-1b and TNFa. These alterations generally persisted through the 13 week sampling. Blood analysis showed few systemic effects from the lunar dust inhalation. By week 4, the peripheral granulocyte percentage was elevated in the treated rats. Plasma cytokine levels were unchanged in all treated rats compared to controls. Peripheral blood analysis showed an increased granulocyte percentage and altered cytokine production profiles consisting of increased in IL-1b and IL-6, and decreased IL-2 production.

**Conclusion:** Lunar dust inhalation results in significant lung inflammation, and some systemic effects, that does not resolve through 13 weeks. Lunar dust may therefore represent a crew health risk during sortie or long-duration Lunar missions.