Lung Exposures to Inhaled Particles Impact Immune Cell Function and Drive Inflammation

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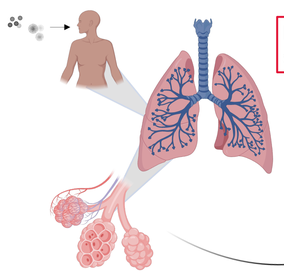
Big Picture

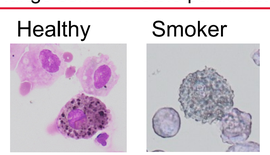
- Small particles, called particulates, are released into the air following combustion
- Examples include industrial pollution, cigarette smoke, and forest fires

Why We Care

- Tiny particulates, called PM2.5, make it deep into the lower airways in the lungs, where they are eaten by immune cells, called **macrophages**
- Normally, these cells break down what they eat, keeping our body safe. (like Pac-man!)
  - Examples include degradable particles, pathogens, and *other dead cells*.

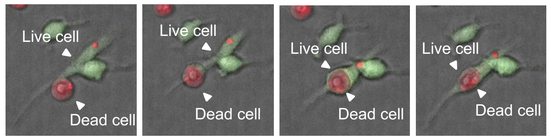


Human cells donated from both healthy and smoker lungs contain visible particulates.



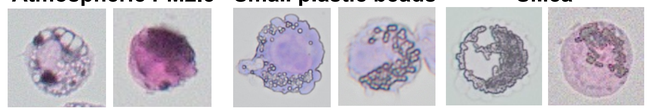
- **However, many particulates cannot be degraded.**
- When a cell dies, non-degradable particulates are transferred to a new, living macrophage
  - *It's like how tattoo ink stays in our skin!*
- ***How does this impact the function of these immune cells? How does it effect lung health?***

What We Found



Living immune cells eat dead cells in the lungs.
Live macrophages in the lungs eat and break down dead cells in health, recycling their contents for energy.

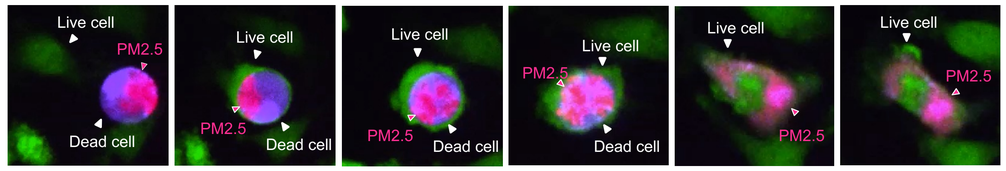
Atmospheric PM2.5 | **Small plastic beads** | **Silica**



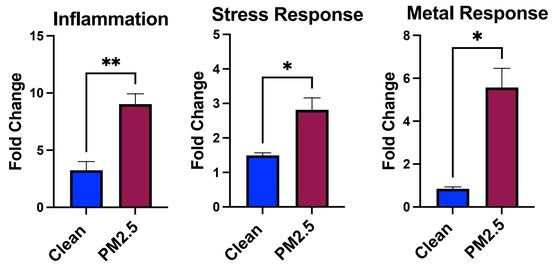
Collected from urban air filters | Microplastics | Common industrial compound

Dead cells keep non-degradable particles inside.

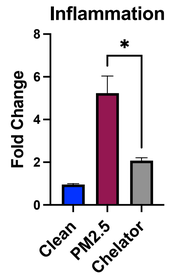
What happens to the particulates in dead cells?



Non-degradable contents in "dirty" dead cells transfer to clean, live immune cells after cell death.
Parts of PM2.5 that cannot be degraded remain in the living cell, fated to be passed onto a new cell when it dies.
These particles persist in the body for long periods of time.



Metals in PM2.5 promote inflammation.
Treatment with a chelator, which is a substance that removes metals, decreases inflammation.

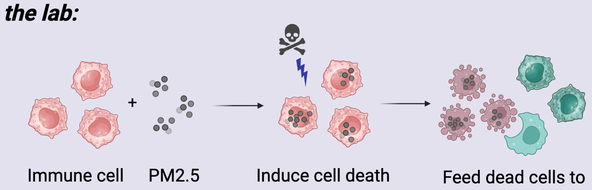


Lung immune cells that ate dead cells with PM2.5 increased expression of disease-promoting genes.
Macrophages increased expression of genes that promote disease after eating dead cells previously exposed to PM2.5.

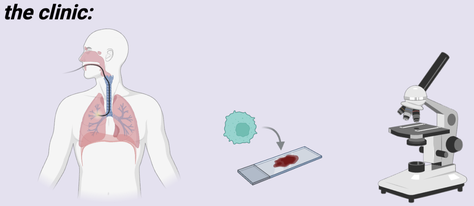
This shows that heavy metals contained in PM2.5 can harm human health.

How We Did the Experiments

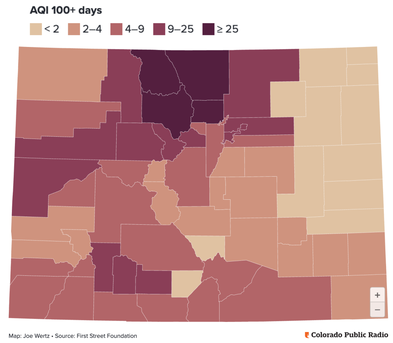
In the lab:



In the clinic:



Impacts in Colorado



Colorado 2024 unhealthy air days estimated per county by regional air quality index with PM2.5 release.

Broader Impacts

- Exposure to inhaled particulates from pollution impacts the lungs.
- Fine particulates, PM2.5, live on in the lungs for long periods of time within immune cells.
- Metals in PM2.5 promote inflammation and damage.
- Long-term inflammation and stress in the lungs increases pulmonary disease risks and impacts human health.

Acknowledgements

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