# Toxicity and Health Effects of Shipping Emission

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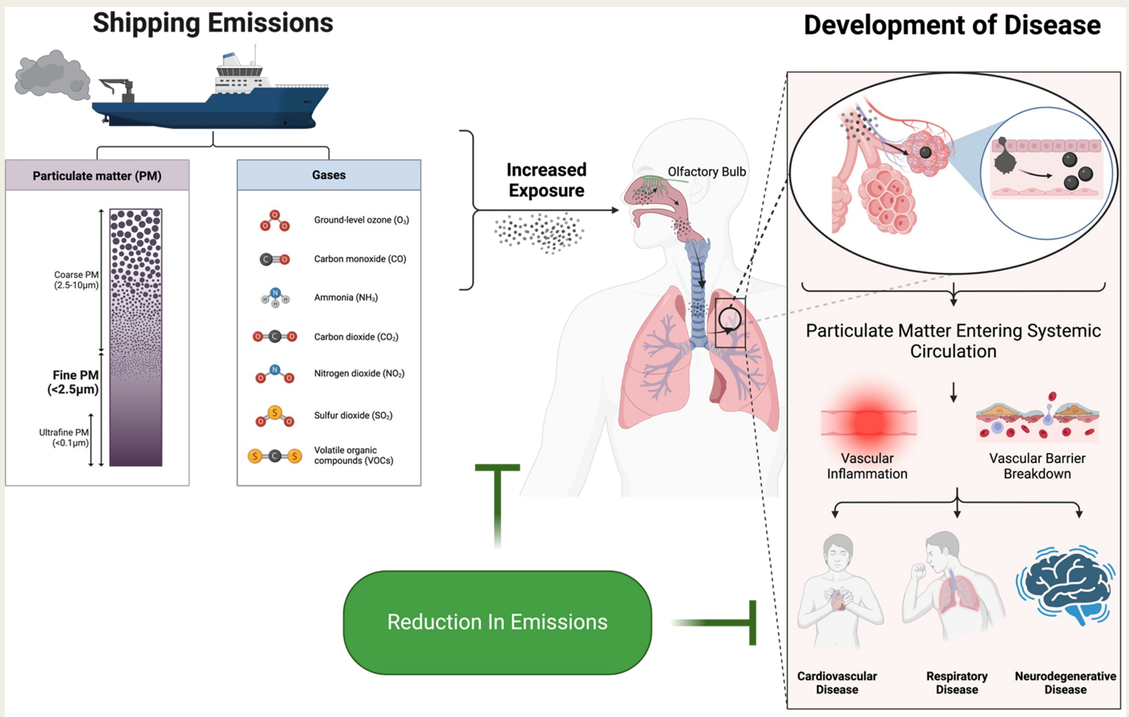
## Background

- Exposure to pollution results in over 7 million deaths annually.
- Maritime transport is a major contributor to air pollution, significantly impacting public health.
- Toxicological studies on emissions from shipping have revealed that particulate matter (PM2.5) and ultrafine particles cause cytotoxicity, oxidative stress, and inflammation. These effects are key contributors and indicators of disease onset, linking shipping emissions to significant adverse health outcomes.



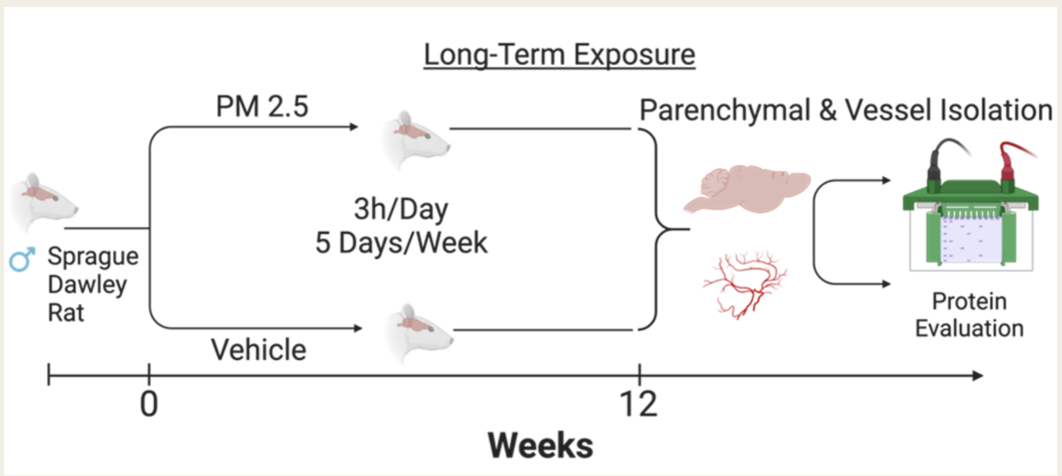

## Aim

Aim: Evaluate the effects of PM 2.5 on inflammation and barrier integrity by using *in vivo* models and human cells.

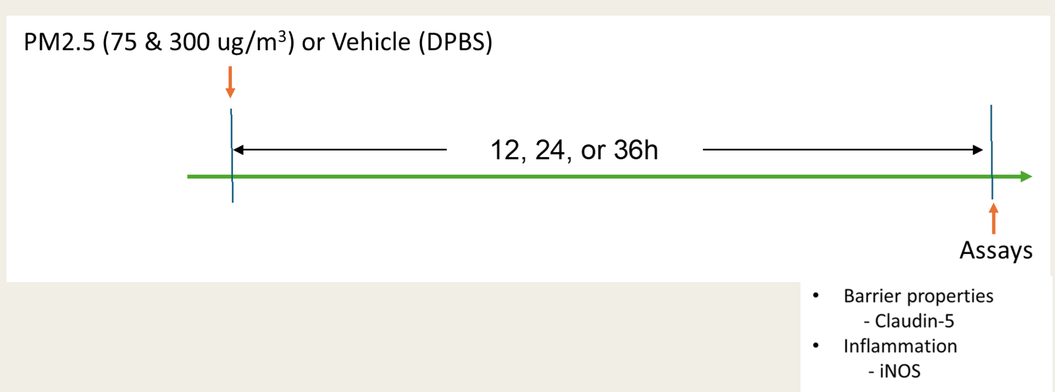
## Methods

PM2.5 collected from southern Sweden was aerosolized with a nebulizer and delivered to male Sprague Dawley rats or tested on human brain endothelial cells. Protein levels of inflammation, apoptosis, and barrier integrity were evaluated.

*In Vivo* Methodology

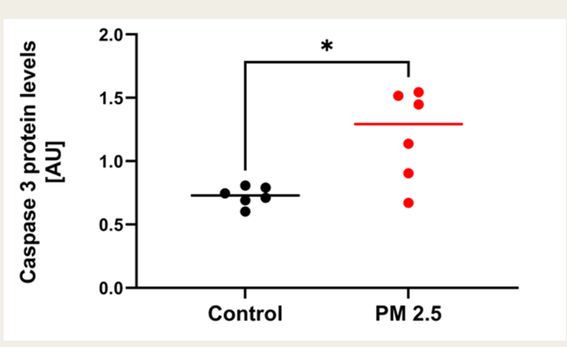


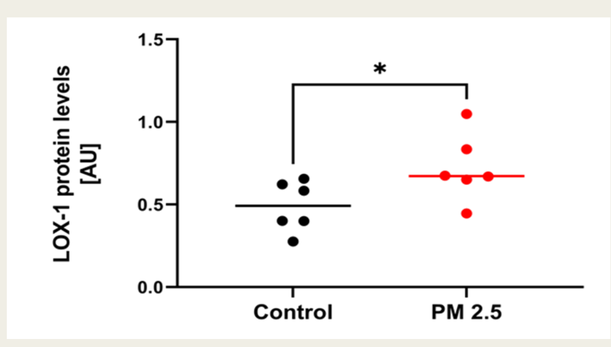

*In Vitro* Human Brain Endothelial Methodology



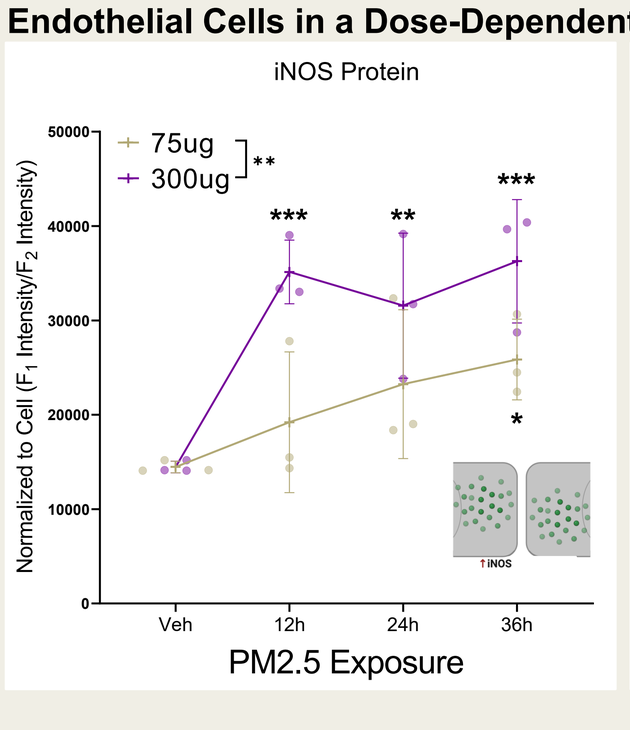

## Results

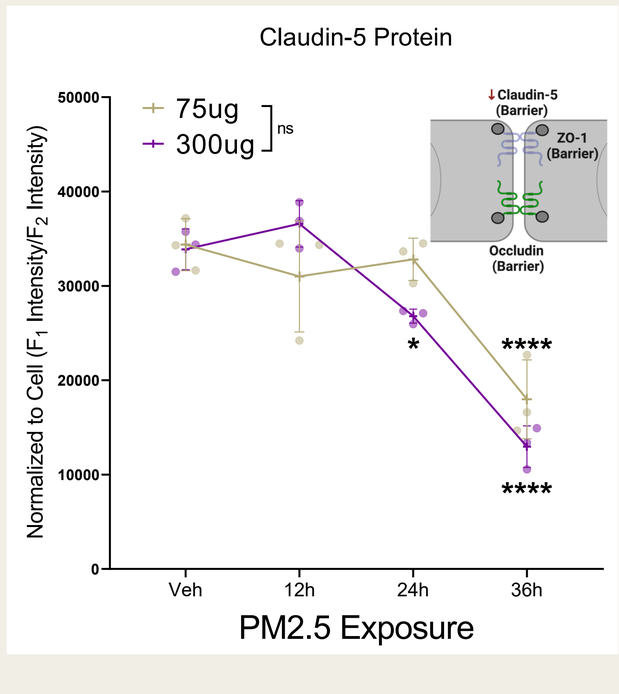
***In vivo* exposure of PM 2.5 Increased Cell Death and Inflammation in the Brain**




**PM 2.5 Increased Inflammation and Vascular Barrier Breakdown in Human Endothelial Cells in a Dose-Dependent Manner**



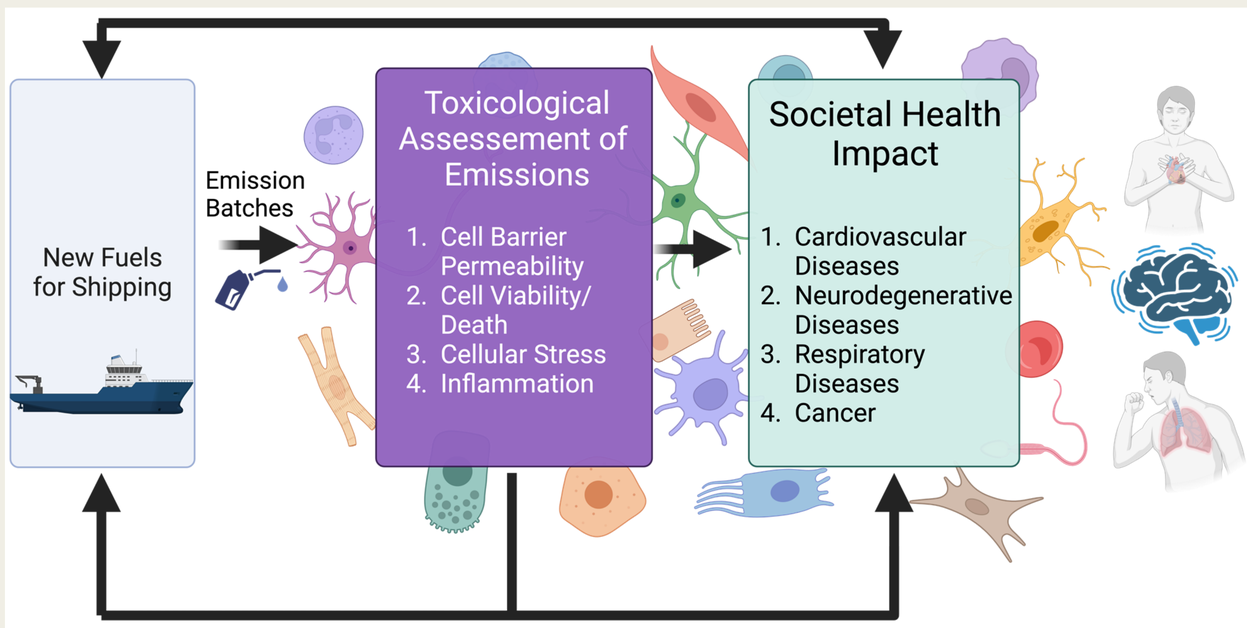

## Summary

Our research, using human cells and in vivo models, has shown that PM 2.5 exacerbates oxidative stress, inflammation and compromises the endothelial cell barrier in a dose dependent manner-these are early indicators of diseases onset.

## Future Potential

Having analyzed the impact of PM 2.5, our research is striving to evaluate the health impact of emissions from new fuels being developed for shipping through human tissue experimentation.

The adoption of new cleaner fuels and energy systems with improved health profiles is essential to comply with the regulations coming in force in the EU and worldwide on shipping especially in ports.

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