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NANOPARTICLE EMISSIONS FROM THE TRANSPORT SECTOR: HEALTH AND POLICY IMPACT.



## Introduction

Road traffic is one of the main emitters of air pollution in cities. An important part of these emissions comes from **non-exhaust** sources like **brakes**, tires, road wear, and road dust resuspension<sup>1</sup>. Brake particles represent an important part of non-exhaust emissions. Their characteristics depend on the speed, load, temperature, and friction pair materials. The metallic components of the brakes may cause the **toxic effects**<sup>2,3</sup>.

**Objective:** This work aimed to evaluate the toxicity (*in vitro*) of fresh airborne particles from 4 car brake materials and 2 train brake materials using an alveolar cell line (A549) exposed at the air-liquid interface (ALI).

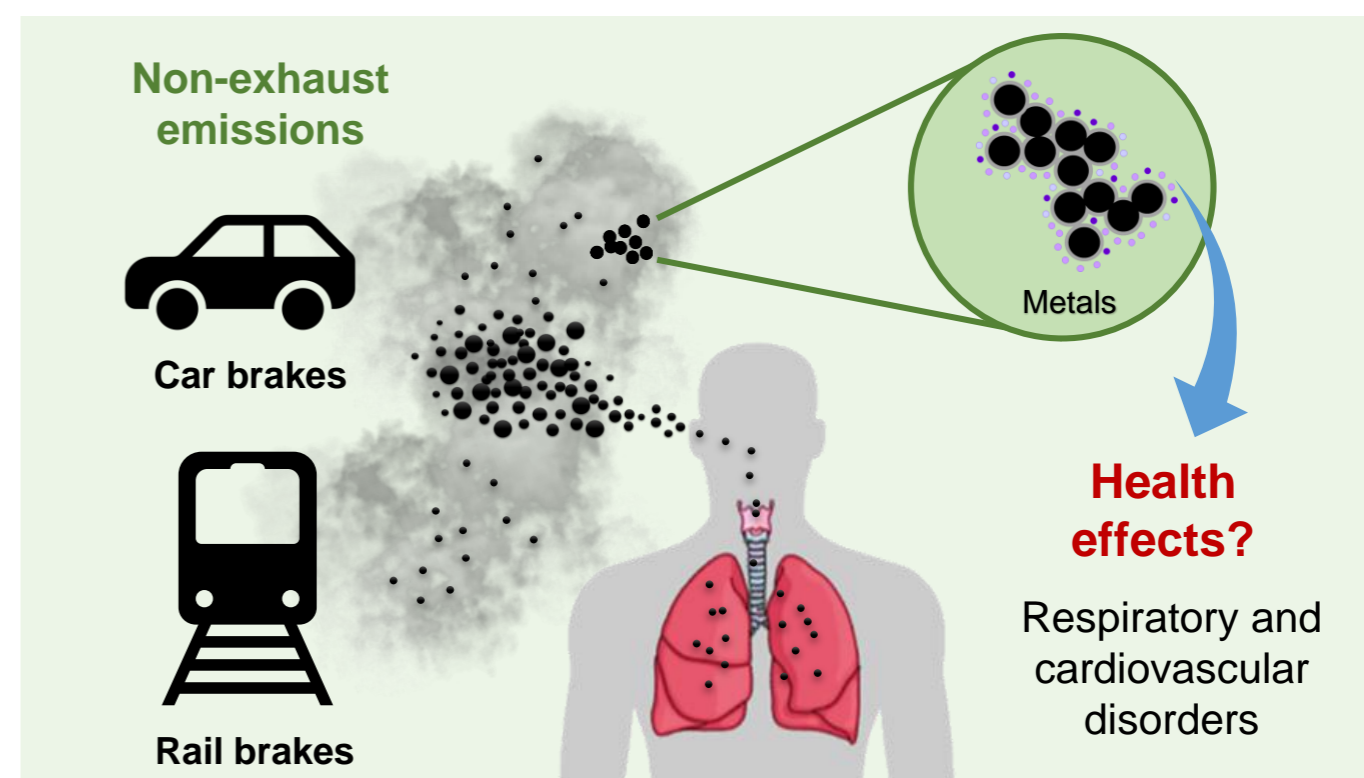
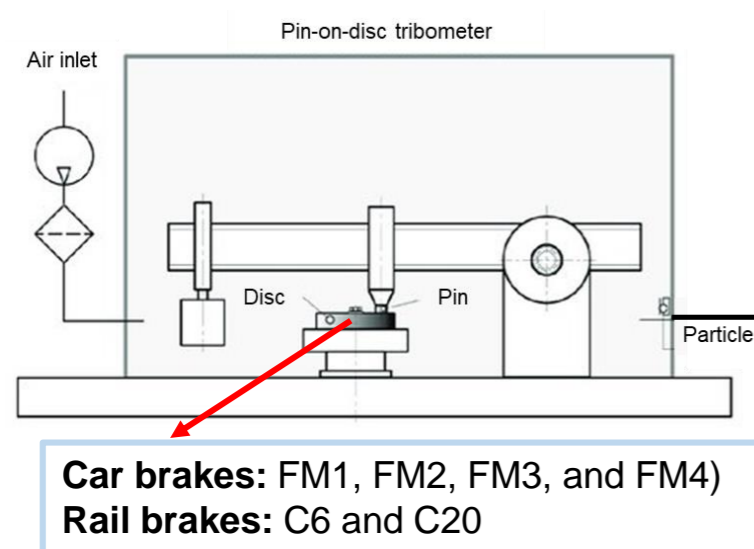


Fig. 1. Particle exposure scenario from non-exhaust sources (car and rail brakes).

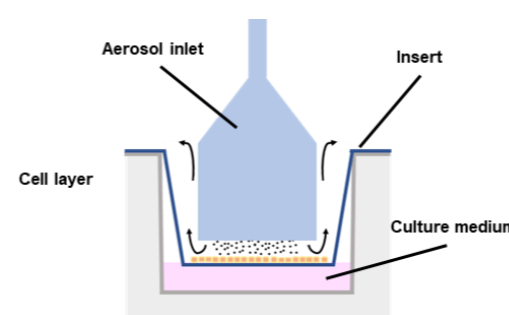
## Methodology

### Particle generation with a tribometer



Toxicological evaluation

Particle characterization



A549 exposed to PM<sub>2.5</sub> at ALI

- Cell viability (Alamar Blue assay)
- Cytokine release (Multiplex assay)

- Particle concentration (GRIMM)
- Particle size distribution (SMPS)

## Results

### Toxicological evaluation

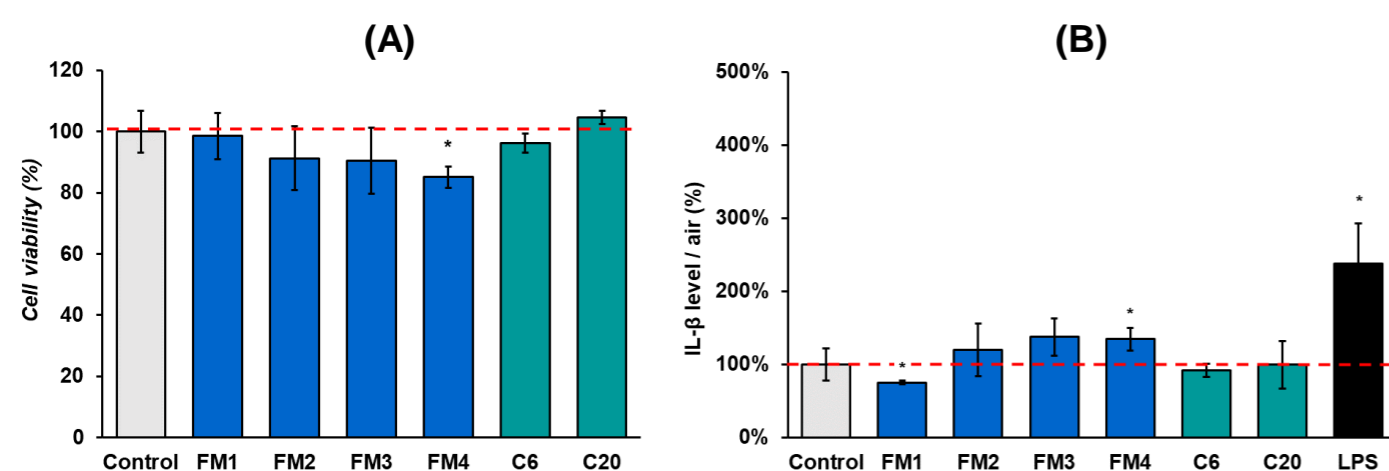


Fig. 2. A. Cell viability (Alamar blue assay). B and C. IL-β and IL-8 release (Multiplex cytokine array analysis). LPS (10 μg/mL) was used as positive control for the cytokine release analysis. Results are expressed as mean ± SD of at least 3 independent experiments. Statistical analysis was performed using the non-parametric Mann-Whitney U test (GraphPad for Windows, v9.4.0). Statistically significant differences were reported with p < 0.05.

### Particle characterization

- Metal composition

**Car brakes:** FM1 and FM2 have a low metal content and are Cu-free, FM3 is Cu-enriched, and FM4 is non asbestos organic (NAO) and Cu-free  
**Train brakes.** There is mainly Ca in C6, and Fe in C20.

- Exposure dose

The estimated exposure dose of the cells was around 4-6 μg/cm<sup>2</sup>.

## Conclusion

- Brake particles decreased cell viability more than the gaseous emissions (control) in three of the car brakes (FM2, FM3, and FM4) and slightly in one of the rail brakes (C6);
- Three of the brake particles (FM2, FM3 and FM4) slightly increase both studied cytokines (IL-β and IL-8);
- The metal content on the particles may explain our results, but further analyses need to be done to better understand the toxicity of these materials e.g., testing different particle fractions using submerged exposures.

## Acknowledgments

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## References

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