NANOTOX 2024
23 - 25 September, Venice, Italy

How might exposure to $PM_{2.5}$ increase the severity of SARS-CoV-2 viral infections?

Sara Marchetti[a], Maurizio Gualtieri[a], Anita Colombo[a], Tobias Stöger[b], Paride Mantecca[a]

[a]POLARIS Research Centre, Department of Earth and Environmental Sciences, University of Milano-Bicocca, Piazza della Scienza 1, 20126 Milano, Italy
[b]Institute of Lung Health and Immunity (LHI), Comprehensive Pneumology Center (CPC-M), Helmholtz Zentrum München, Ingolstädter Landstraße 1, Neuherberg/München, Germany

Literature data suggest that environmental exposure to fine airborne particles ($PM_{2.5}$) increases the occurrence and severity of respiratory viral infections in humans. In presence of $PM_{2.5}$, viruses could potentially determine more severe infections due to altered immune homeostasis. Although it is known that physicochemical properties, such as size, determine the site of particle deposition and accumulation in the airways, recent suggestions show the possibility of interaction between PM and viruses. However, data on whether these interactions influence virus-mediated inflammatory effects are missing.
Regarding SARS-CoV-2 infection, exposure to $PM_{2.5}$ has been associated with a higher incidence of the COVID-19 disease. In a previous work, we report that exposure to $PM_{2.5}$ facilitates virus internalization through the angiotensin 2 converting enzyme (ACE2) - dependent pathway. In fact, pulmonary alveolar epithelial cells exposed to $PM_{2.5}$ in submerged conditions over-expressed ACE2, which is exploited by SARS-CoV-2 viral particles to enter the cells and increase their inflammatory state.
Studying biological responses in more complex models, including co-cultures systems of lung cells with other cell types, could be useful to further explore the inflammatory and immunological effects of combined exposure to air pollution and SARS-CoV-2. For this purpose, co-cultures of differentiated macrophage-like THP-1 cells and epithelial cells (1:10 ratio) exposed to $PM_{2.5}$ in combination or not with viral particles (inactivated SARS-CoV-2) could be useful to mimic a more realistic *in vivo* situation for the evaluation of possible synergistic effects. The role of THP-1-like macrophages will be therefore useful to evaluate their influence in the response of epithelial cells to $PM_{2.5}$ and SARS-CoV-2. Consequently, the inflammatory potential triggered by winter $PM_{2.5}$ and the SARS-CoV-2 virus will be explored.
Our results indicate that the interaction between $PM_{2.5}$ and SARS-CoV-2 influences the severity of the inflammatory responses in lung epithelial cells, exacerbating the effects of the viral infection. These findings deepen the understanding of the additional risk posed by airborne PM in facilitating and worsening virus-mediated respiratory disease in exposed populations.