



HAL
open science

Human biological monitoring of nanoparticles, a new way to investigate potential causal links between exposure to nanoparticles and lung diseases?

V. Forest, J. Pourchez

► **To cite this version:**

V. Forest, J. Pourchez. Human biological monitoring of nanoparticles, a new way to investigate potential causal links between exposure to nanoparticles and lung diseases?. *Pediatric Pulmonology*, 2022, 29 (1), pp.4 - 5. 10.1016/j.pulmoe.2022.08.005 . hal-03921786

HAL Id: hal-03921786

<https://hal.science/hal-03921786>

Submitted on 4 Jan 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



COMMENT

Human biological monitoring of nanoparticles, a new way to investigate potential causal links between exposure to nanoparticles and lung diseases?



V. Forest*, J. Pourchez

Mines Saint-Etienne, Université Lyon, Université Jean Monnet, Etablissement Français du Sang, INSERM, U1059 Sainbiose, Centre CIS, F-42023 Saint-Etienne, France

Received 2 August 2022; accepted 8 August 2022
Available online 15 September 2022

In addition to ultra-fine particles produced naturally or unintentionally released as a consequence of human activities, engineered nanomaterials are produced purposefully to take advantage of their unique physicochemical characteristics associated with their nanostructure. The growing development and applications of nanomaterials lead to an increasing release of these materials into the environment and consequently we are increasingly exposed to them.

Inhaled nanoparticles can deeply affect human health, especially, but not exclusively, in the context of air pollution. An update of the World Health Organization's air quality database was released in April 2022, warning that significant harm can be caused by even low levels of air pollutants.¹ As lungs are directly and constantly exposed to airborne pollutants, the effects of air pollution on the respiratory system has received much attention. Correlations have been reported between air pollution, especially particulate matter (PM), and the incidence and mortality of lung cancers.^{2–4} PM was classified as a group I human carcinogen by the International Agency for Research on Cancer (IARC) based on data from human, animal and mechanistic studies.^{5,6} But other cancers are also suspected to be related to air pollution such as childhood leukemia, cancers of the gastro-intestinal tract, bladder and kidney cancers or breast cancers.

In any case, inhaled nanoparticles can accumulate within the lungs where they are able to induce tissue damages. It

has been especially reported that biopersistent engineered nanoparticles can induce pro-inflammatory reaction and oxidative stress, creating a microenvironment favorable to the development of diseases and especially cancers. In addition, due to their small size, inhaled nanoparticles can also cross the blood-air barrier and be distributed to other organs where they can trigger further damage.

Although epidemiological studies are informative, they are time- and resource- consuming. To get a better understanding of the chain of events from exposure to disease, alternative approaches such as the biological monitoring of biopersistent nanoparticles in patients could be used. Indeed, such biomonitoring would allow for the quantification of the internal dose of inhaled biopersistent particles, which differs from the external dose that can be measured by ambient monitoring (*i. e.*, atmospheric metrology). The assessment of the internal dose is a first step towards the characterization of persistent engineered nanoparticles in tissues and the understanding of this potential source of adverse effects.^{7–9}

This approach has led to suggestions about the contribution of silica submicron particles to the development of sarcoidosis,¹⁰ providing new research avenues. Similarly, it could improve understanding of the factors, which if they not actually cause may at least contribute to the development of cancers.

Combining the biomonitoring of nanoparticles in human samples and toxicological studies could improve understanding of the pathways involved in cancer development and also play a part in prevention, by limiting exposure to the incriminated sources of hazard.

* Corresponding author.

E-mail address: vforest@emse.fr (V. Forest).

In conclusion, the biological monitoring of nanoparticles in human samples appears as an alternative approach to time- and resource- consuming epidemiological studies to highlight relationships between exposure to nanoparticles and lung diseases development.

Conflicts of interest

none.

CRedit authorship contribution statement

V. Forest: Conceptualization, Writing – original draft. J. Pourchez: Writing – review & editing.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. World Health Organization. Billions of people still breathe unhealthy air: new WHO data. 2022; published online April 4.

2. <https://www.who.int/news/item/04-04-2022-billions-of-people-still-breathe-unhealthy-air-new-who-data> [Accessed 22 April 2022].
3. Mayoralas-Alises S, Diaz-Lobato S. Air pollution and lung cancer. *Curr Respir Med Rev.* 2012;8:418–29.
4. Raaschou-Nielsen O, Andersen ZJ, Beelen R, et al. Air pollution and lung cancer incidence in 17 European cohorts: prospective analyses from the European Study of Cohorts for Air Pollution Effects (ESCAPE). *Lancet Oncol.* 2013;14:813–22.
5. Wong GWK. Air pollution and health. *Lancet Respir Med.* 2014;2:8–9.
6. IARC. Outdoor Air Pollution. Lyon, 2013 <https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Outdoor-Air-Pollution-2015> [Accessed 21 April 2022].
7. Loomis D, Grosse Y, Lauby-Secretan B, et al. The carcinogenicity of outdoor air pollution. *Lancet Oncol.* 2013;14:1262–3.
8. Bergamaschi E, Poland C, Guseva Canu I, Prina-Mello A. The role of biological monitoring in nano-safety. *Nano Today.* 2015;10:274–7.
9. Groopman JD, Kensler TW. The light at the end of the tunnel for chemical-specific biomarkers: daylight or headlight? *Carcinogenesis.* 1999;20:1–11.
10. Forest V, Vergnon J-M, Pourchez J. Biological monitoring of inhaled nanoparticles in patients: an appealing approach to study causal link between human respiratory pathology and exposure to nanoparticles. *Chem Res Toxicol.* 2017;30:1655–60.
11. Forest V, Pourchez J, Guibert C, et al. Nano to micron-sized particle detection in patients' lungs and its pathological significance. *Environ Sci: Nano.* 2019;6:1343–50.