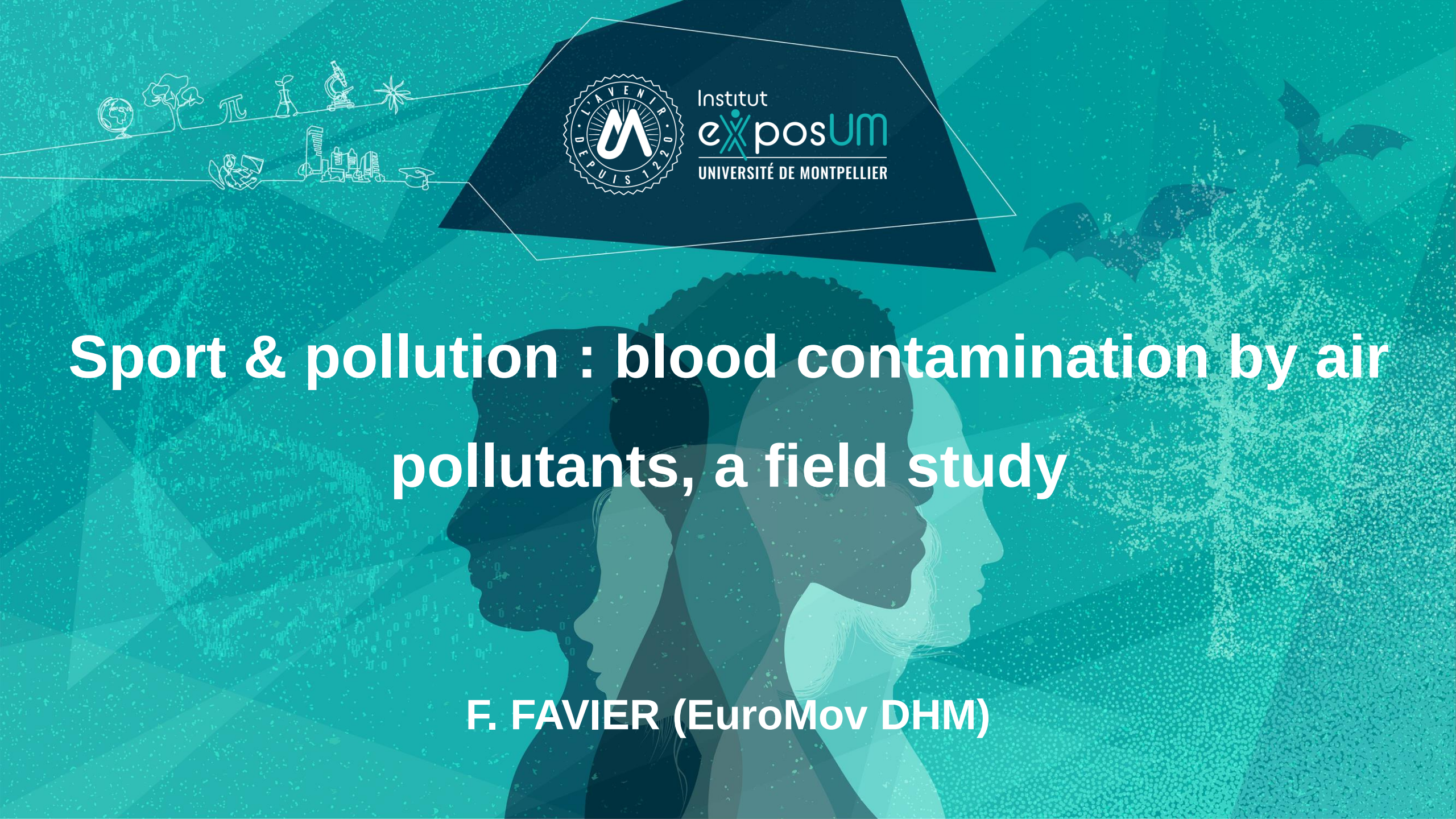



# Sport & pollution : blood contamination by air pollutants, a field study

F. FAVIER (EuroMov DHM)

# Air pollution & (human) health

In France (2016-2019)

- ≈ 40 000 deaths (> 30 yr) due to Particulate Matter (PM) exposure
- ≈ 70-100 billions €

Worldwide (2019)

- 4.2 millions of premature deaths due to outdoor air pollution
- 99% of the population living in areas where WHO recommended air quality thresholds are not met

https://www.who.int/fr/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

# Air pollution & (human) health

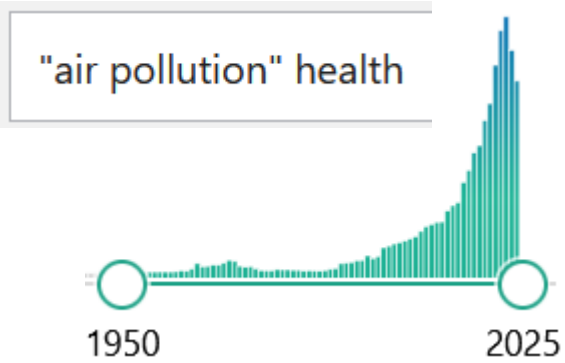
Immediate effects

- Eye irritations
- Respiratory tract irritations (asthma)
- Exacerbation of cardiovascular disorders

Long term effects

=> Development or worsening of chronic diseases such as

- Cancer
- Cardiovascular pathologies
- Respiratory pathologies
- Neurological / cognitive disorders

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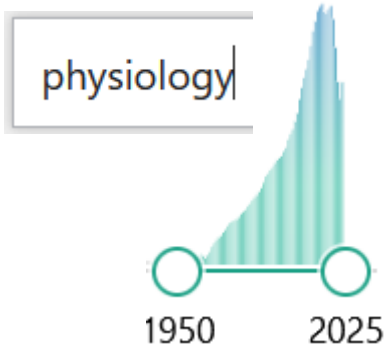


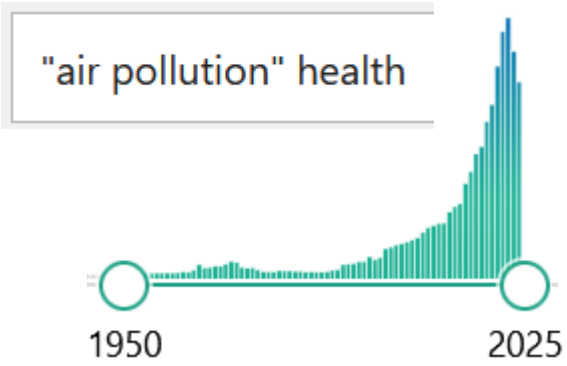


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# Air pollution & (human) health

Effects on environment

- Ecosystems
- Agricultural yields

# Which pollutants?

**PM:** $PM_{10}$, $PM_{2.5}$, $PM_1$

**Gases:**

CO and $CO_2$

Sulfur Dioxide ($SO_2$), Hydrogen Sulfide ($H_2S$)

Nitric Oxide (NO), Nitrogen Dioxide ($NO_2$)

Ozone ($O_3$)

# Which pollutants?

**PM:** $PM_{10}$, $PM_{2.5}$, $PM_1$

**combustion: hydrocarbons, wood, tabac**

**Gases:**

CO and $CO_2$

Sulfur Dioxide ($SO_2$), Hydrogen Sulfide ($H_2S$)

Nitric Oxide (NO), Nitrogen Dioxide ($NO_2$)

Ozone ($O_3$)

=> geographic and seasonal variations

# Which pollutants?

**Polycyclic Aromatic Hydrocarbons (PAHs)**

16 = « high priority pollutants » (US Environment Protection Agency)

(e.g. benzo[a]pyren, a proven carcinogen)

https://www.cancer-environnement.fr/fiches/expositions-environnementales/hydrocarbures-aromatiques-polycycliques-hap/

**Pesticides**

« born to kill »

Agricultural areas (only?)

Measured in outdoor air since 2000… no thresholds/standards?

https://www.anses.fr/fr/content/contamination-de-lair-par-les-pesticides

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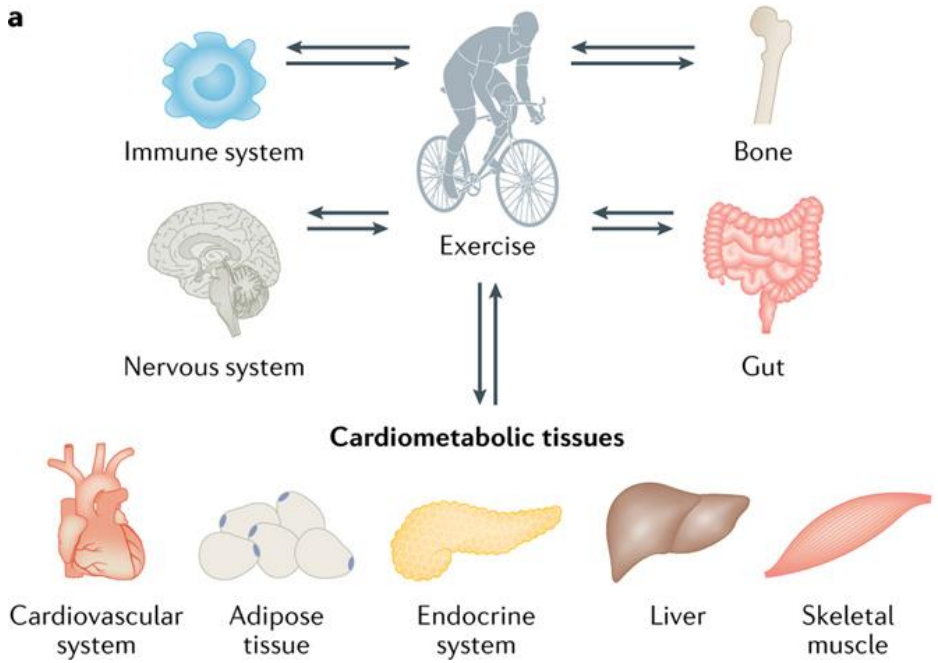
# Improve health: the best medicine ever…

## …practicing physical activity & fighting against sedentarity lifestyle




Chow & al. Nat Rev Endocrinol. 2022 May; 18(5): 273–289.

# Improve health: the best medicine ever…

**…but what if exercise is performed in pollutated area?**

# Exercise in polluted air

Randomized Controlled Trial > J Appl Physiol (1985). 2024 Jun 1;136(6):1507-1515. doi: 10.1152/japplphysiol.00085.2024. Epub 2024 Apr 25.

**Ozone exposure limits cardiorespiratory function during maximal cycling exercise in endurance athletes**

Observational Study > Environ Int. 2023 May:175:107943. doi: 10.1016/j.envint.2023.107943. Epub 2023 Apr 27.

**Air pollution and elite adolescent soccer players' performance and well-being; an observational study**

> Sci Total Environ. 2022 Oct 10:842:156825. doi: 10.1016/j.scitotenv.2022.156825. Epub 2022 Jun 22.

**Amateur runners more influenced than elite runners by temperature and air pollution during the UK's Great North Run half marathon**

**$NO_2$, $PM_{10}$ and $O_3$ related to performance, physiological parameters and perceived difficulty**

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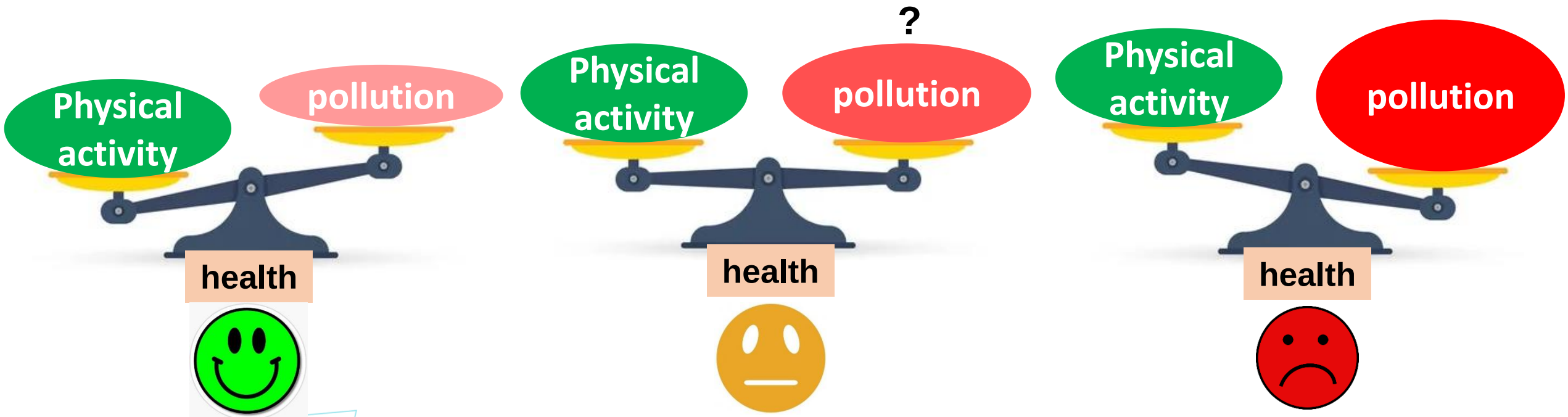
# Exercise in polluted air

**The big question:**



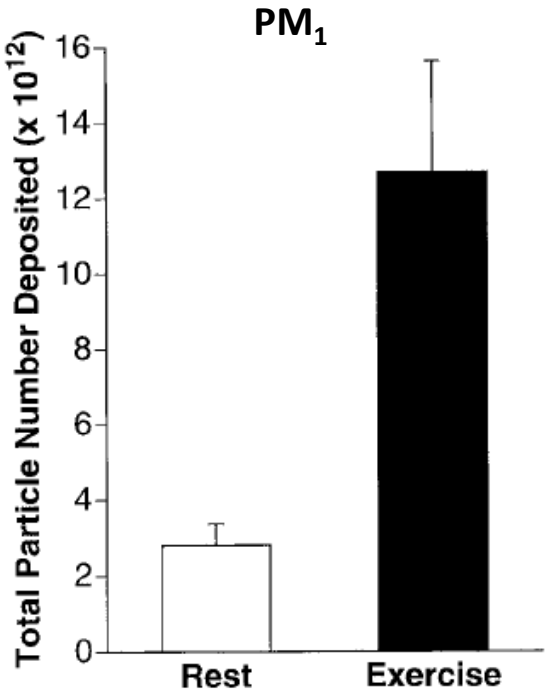
# Exercise in polluted air

Exercise can increase minute ventilation more than 10x…

…with enhanced bronchodilatation and alveoli perfusion

**=> Increased risk of blood contamination by air pollutants**

**15 min of moderate exercise ($V_E$ ≈ x4) in polluted air**




Daigle & al. Inhal Toxicol 2003 May;15(6):539-52

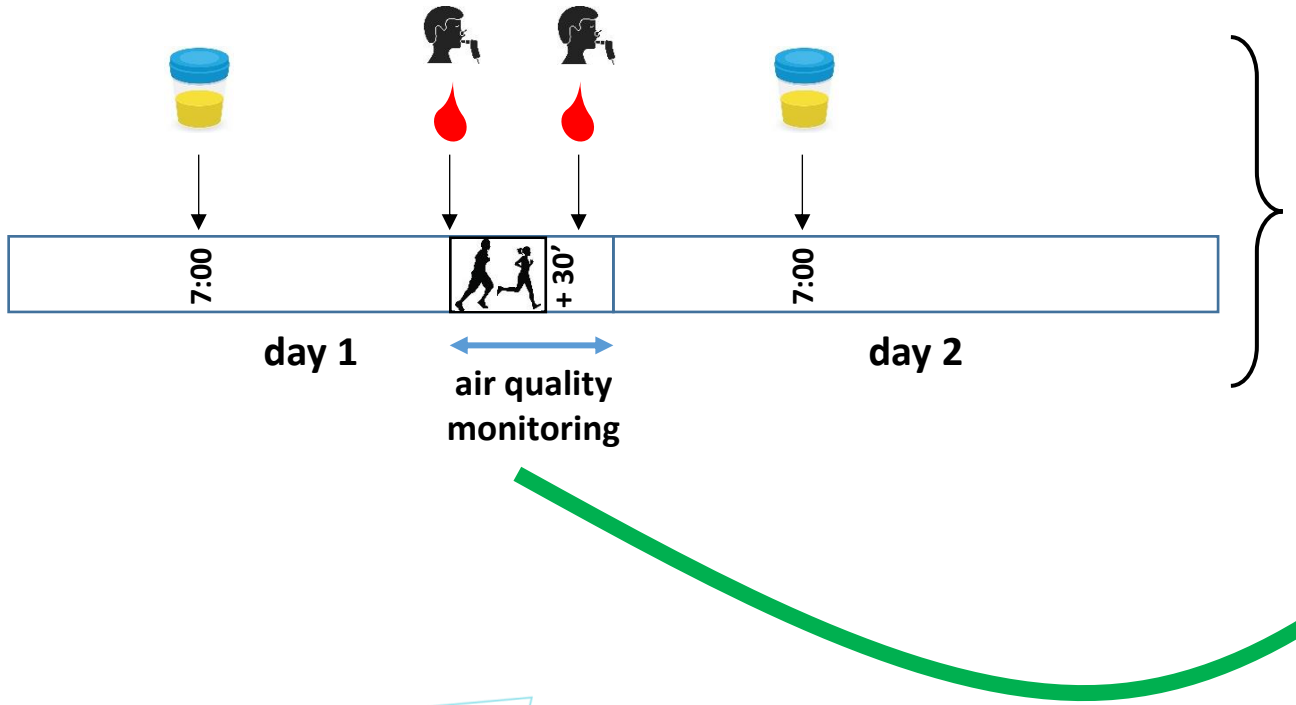
# Exercise in polluted air

- Few data

- Often in defined/controlled conditions (ethical concerns!)
- With a restricted list of pollutants ($O_3$ or $PM_{2.5}$), measured far from the place of interest

- No information of the subsequent presence of pollutants in the blood

# The BLOODPOL project





- Suspended Particulate Matters with size less than 2.5µ ($PM_{2.5}$)
- Suspended Particulate Matters with size less than 10µ ($PM_{10}$)
- Ultra Fine Particulate Matters with size less than 1µ ($PM_1$)
- Total Suspended Particulates ($PM_{100}$)
- Carbon Dioxide ($CO_2$)
- Carbon Monoxide (CO)
- Sulfur Dioxide ($SO_2$)
- Nitric Oxide (NO)
- Nitrogen Dioxide ($NO_2$)
- Ozone ($O_3$)
- Hydrogen Sulfide ($H_2S$)
- Ambient Noise
- Light Intensity
- UV Radiation (0-12 UVI)
- Visible Light Intensity
- Temperature
- Humidity
- Barometric Pressure

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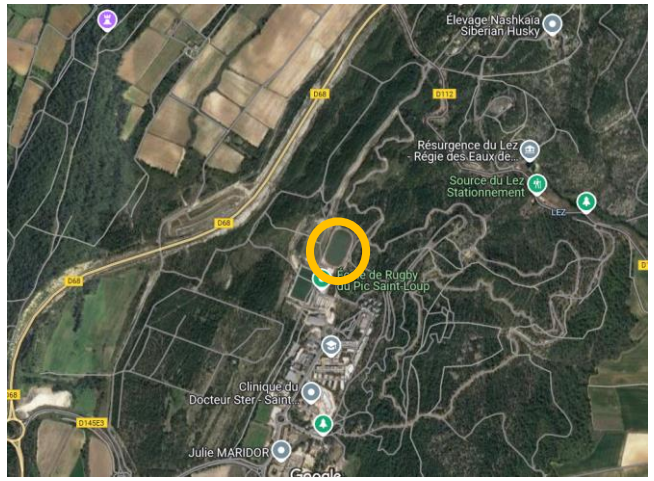
JC AUBIN
S RACINAIS

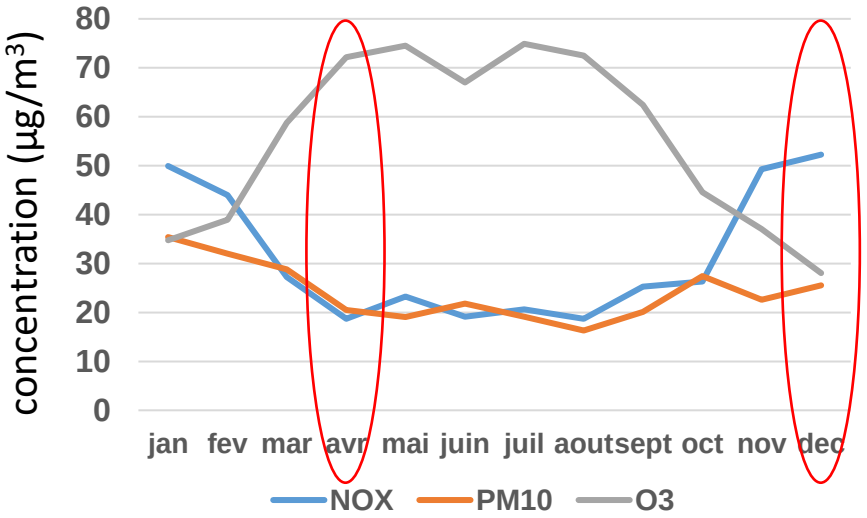
# The BLOODPOL project

**2 places of practice**

**x**

**2 seasons**

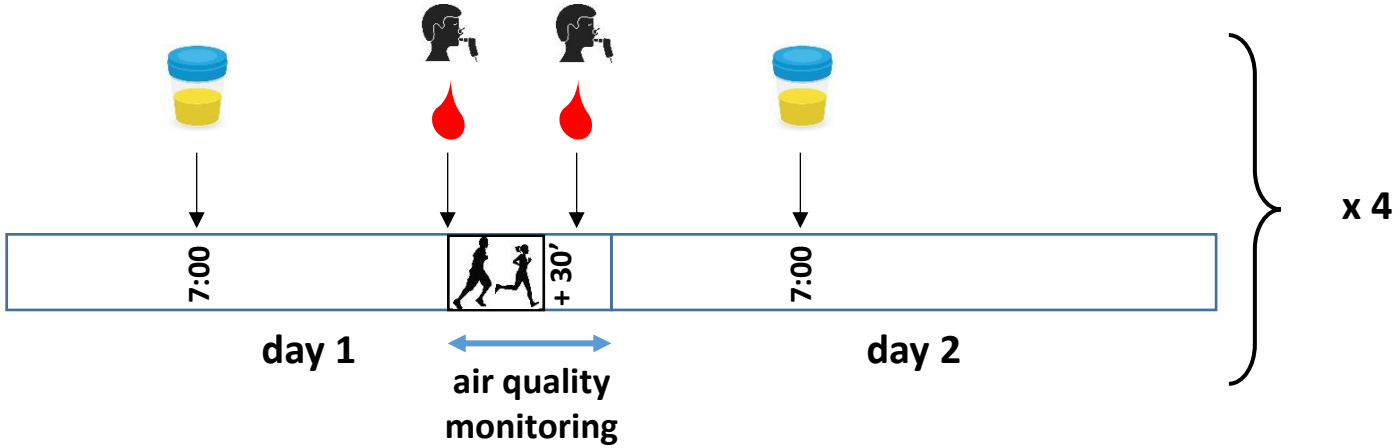




Air pollution Chaptal st, Montpellier
Data analyzed from ATMO Occitanie

https://www.atmo-occitanie.org/

# The BLOODPOL project


**signs of pulmonary inflammation**




x 4

- urine sample
- fractional exhaled NO
- blood sample
- running exercise

# The BLOODPOL project


**signs of pulmonary inflammation**

Int J Environ Res Public Health. 2020 Dec 3;17(23):9012. doi: 10.3390/ijerph17239012.

## Acute FeNO and Blood Pressure Responses to Air Pollution Exposure in Young Adults during Physical Activity

The correlation analysis showed low but statistically significant positive correlations between post-exercise ΔFeNO during exposure trials and ambient air pollutants ($NO_2$ Spearman's $\rho = 0.40$, $p < 0.001$; $NO_x$ $\rho = 0.37$, $p < 0.001$; NO $\rho = 0.36$, $p = 0.001$, $PM_{10}$ $\rho = 0.31$, $p = 0.007$) and outdoor humidity (HUM) and atmospheric pressure (ATMP) (HUM $\rho = 0.41$, $p < 0.001$; ATMP $\rho = 0.27$, $p = 0.01$). There were no significant correlations between ΔFeNO and indoor particulate matter, nor longer exposure lags (3 h average concentrations).

Meta-Analysis > Eur Rev Med Pharmacol Sci. 2022 Jan;26(2):462-470.
doi: 10.26355/eurrev_202201_27871.

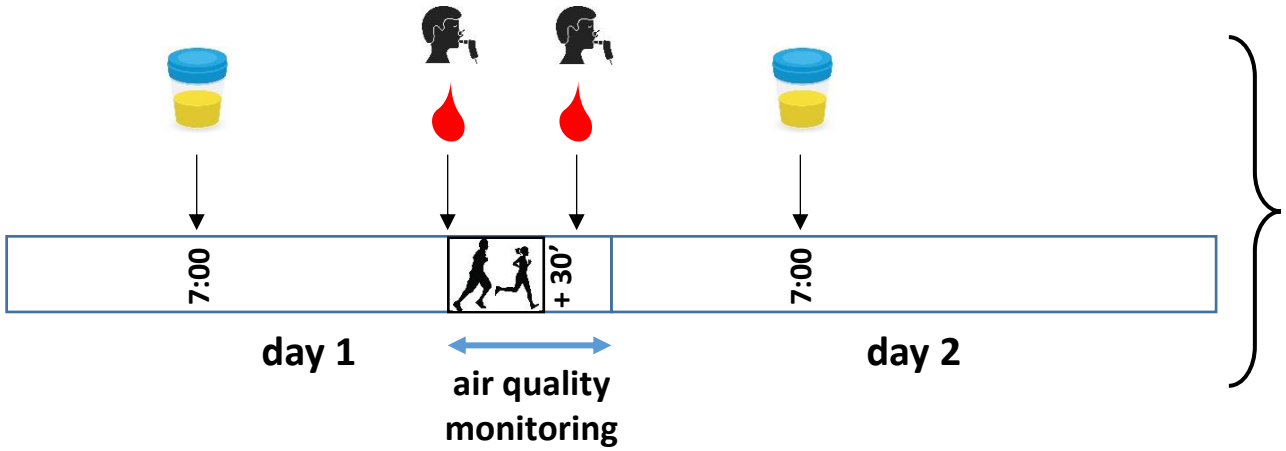
## Effects of air pollutant exposure on lung function in exercisers: a systematic review and meta-analysis

### Conclusions

Overall, our study systematically reviewed 14 interventional studies on the impact of air pollutant exposure on the lung function of the exercisers and found that air pollutant exposure can significantly increase the FeNO level of the exercisers, but the effect on FVC, $FEV_1$ and PEF is not significant. It may cause allergic airway inflammation and adversely affect human health.

# The BLOODPOL project

« UrinePol » ☺




x 4

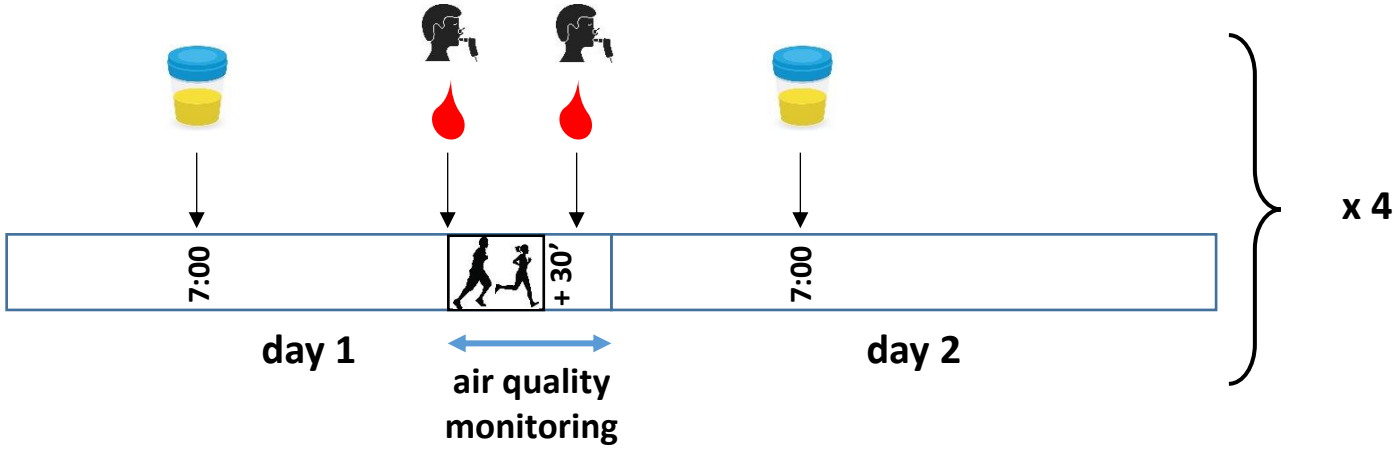
urine sample

fractional exhaled NO

blood sample

running exercise

# The BLOODPOL project




**« UrinePol » ☺**

- urine sample
- fractional exhaled NO
- blood sample
- running exercise

**Dried blood spot + GC-MS/MS**

- PAHs (n=16)
- Pesticides
- Organophosphate esthers

MAMMA
Montpellier Alliance for Metabolomics and Metabolism Analysis

**A. TURTOI**
**S. HENRY**

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# The BLOODPOL project

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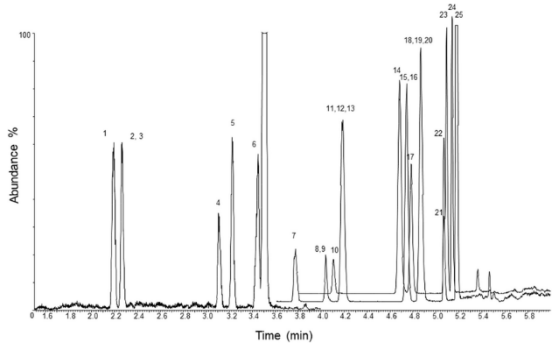
**Prediction?**
**Biomarkers?**




- ❑ PAHs (n=16)
- ❑ Pesticides
- ❑ Organophosphate esthers

IMT Mines Alès
École Mines-Télécom

**N. SUTTON-CHARANI**

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# Thank you for your attention!

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