

Health impacts of air pollution: is there anything more to add?

**The Science and Technology Facilities Council
(STFC) Air Quality Network+**

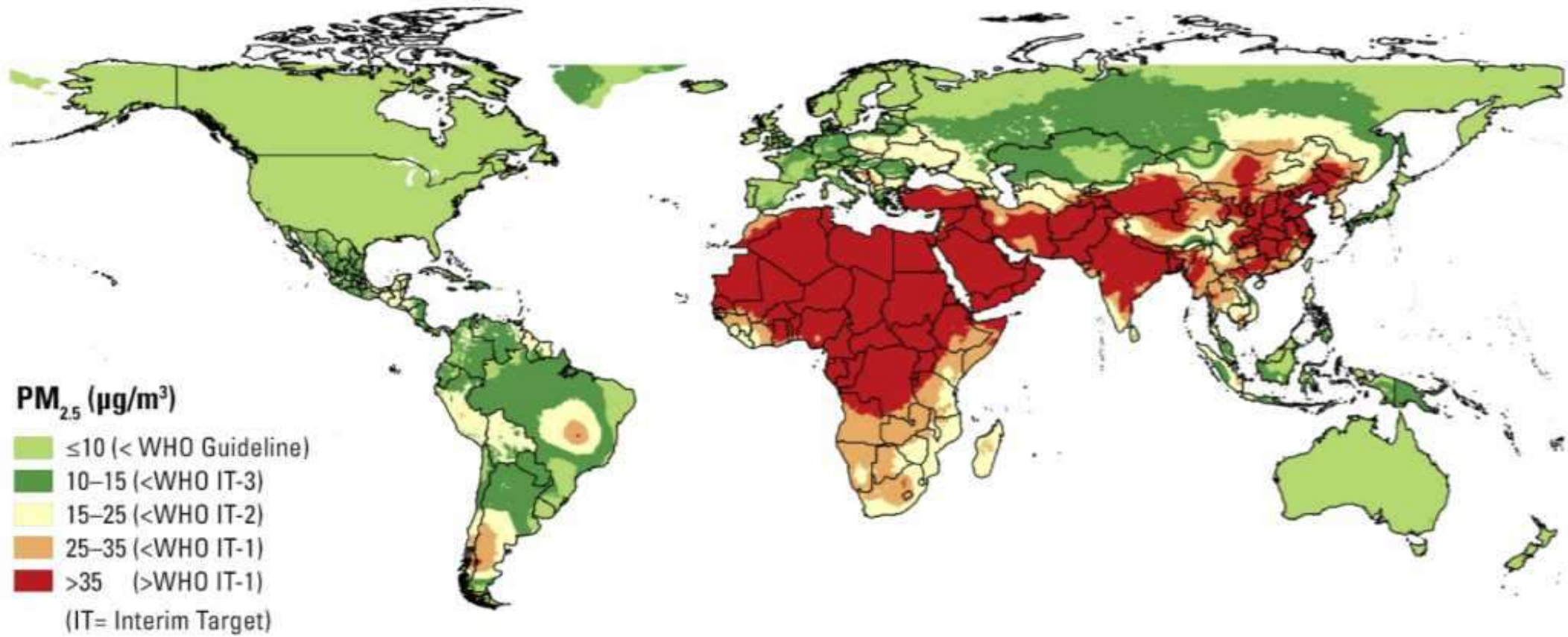
Ian Mudway
MRC Centre for Environment and Health
NIHR-HPRU - Health impact of environmental hazards
Asthma UK Centre in Allergic Mechanisms of Asthma

Adverse effects of poor air quality on health across the life course

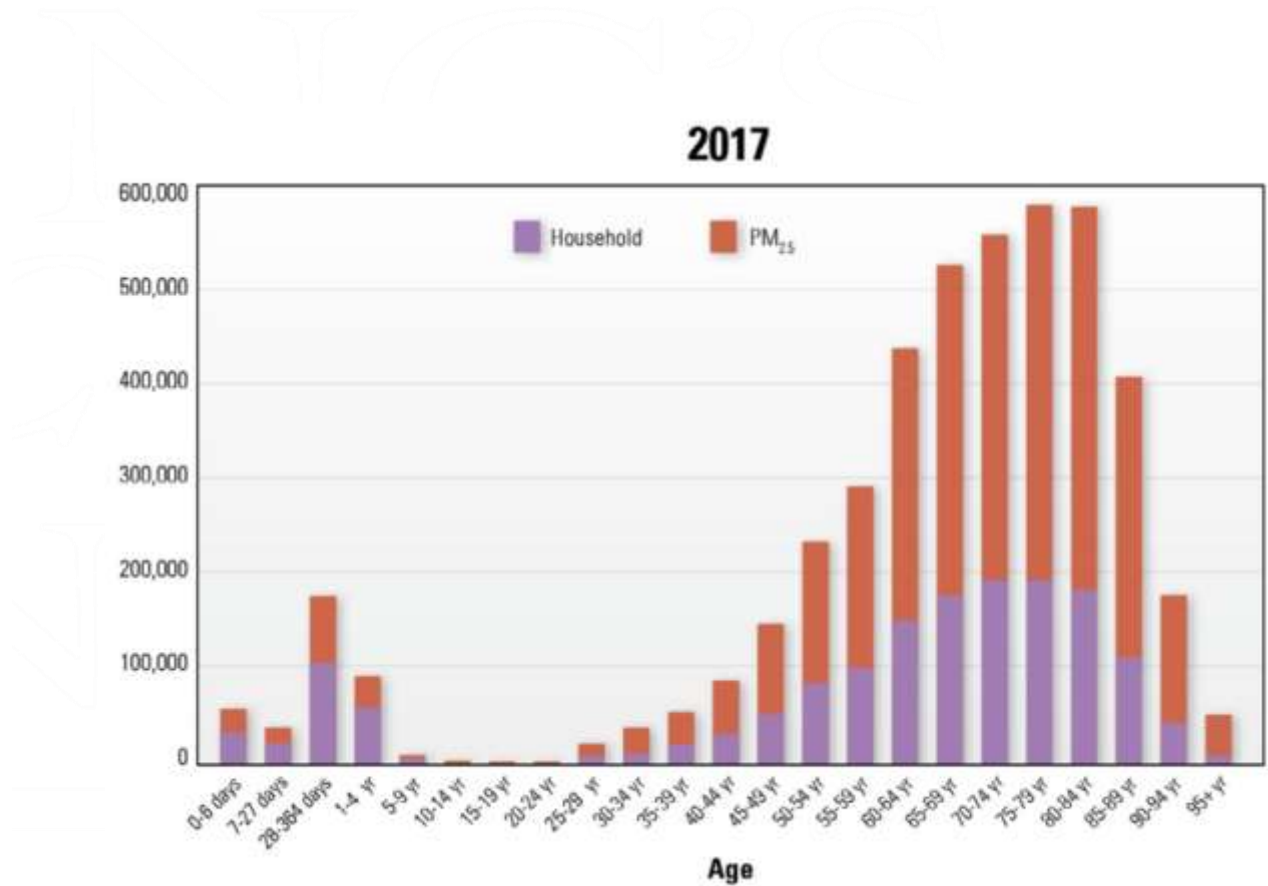
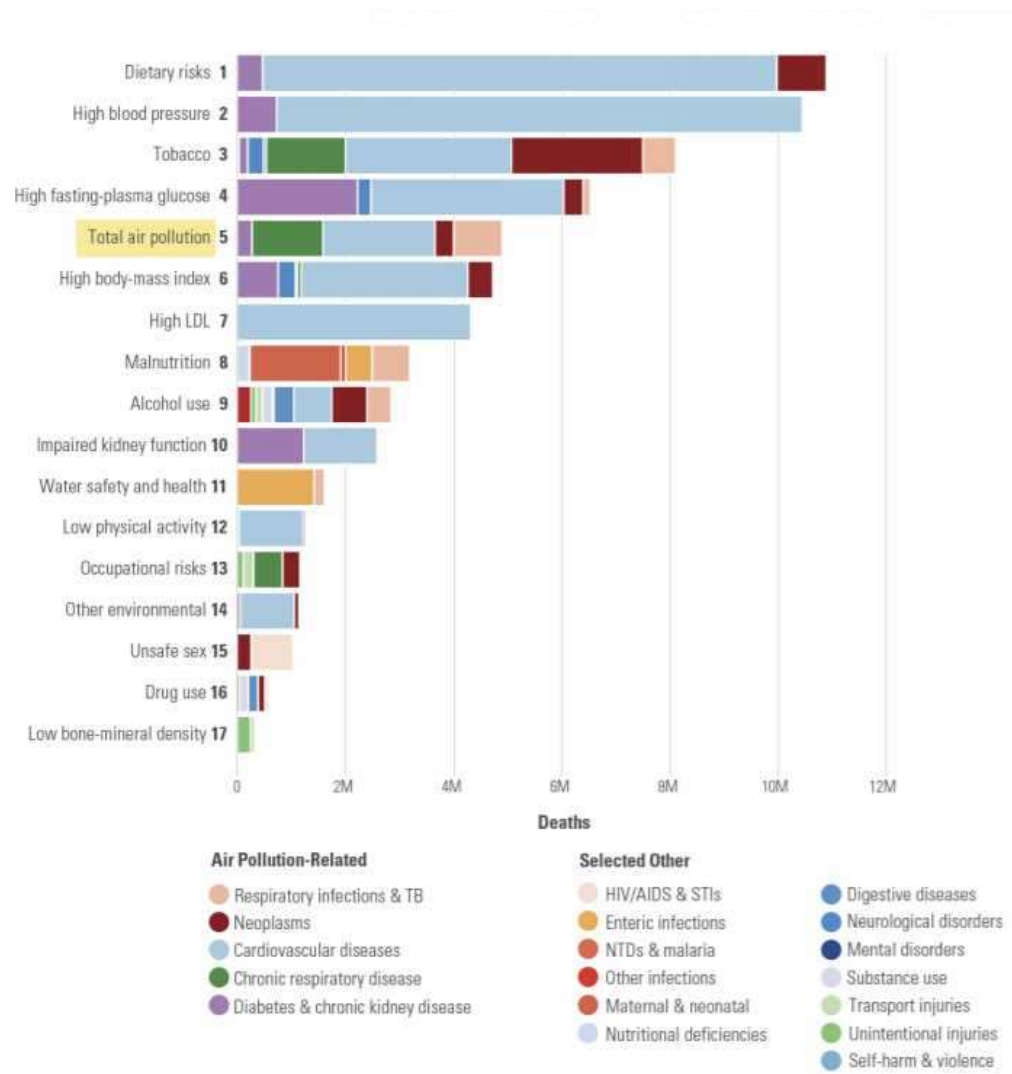
- Low birth weight (Smith 2017; ESCAPE, Pederson 2013)
- Incident asthma (Bharadwaj 2016)
- Pneumonia, asthma attacks, URTI (Peel 2005)
- Cardio-respiratory mortality (Hoek 2014)
- Type II diabetes (Yang. 2019)
- Lung cancer incidence and survival (Eckel 2016)
- Dementia (Chen 2017)
- Impacts of mental health (Braithwaite 2019)
- Developmental deficits (Mudway 2019)



Annual average PM_{2.5} concentrations in 2017 relative to the WHO Air Quality Guideline.



Global ranking of risk factors by total number of deaths from all causes for all ages and both sexes in 2017.



Review, upon review, upon review



World Health
Organization
REGIONAL OFFICE FOR Europe

Health risks of air
pollution in Europe

HRAPIE project

New evidence
from a

Michael and Gabrielle
Chan



This publication arises from the HRAPIE project and has
received funding from the European Union.

How much more evidence do we need?

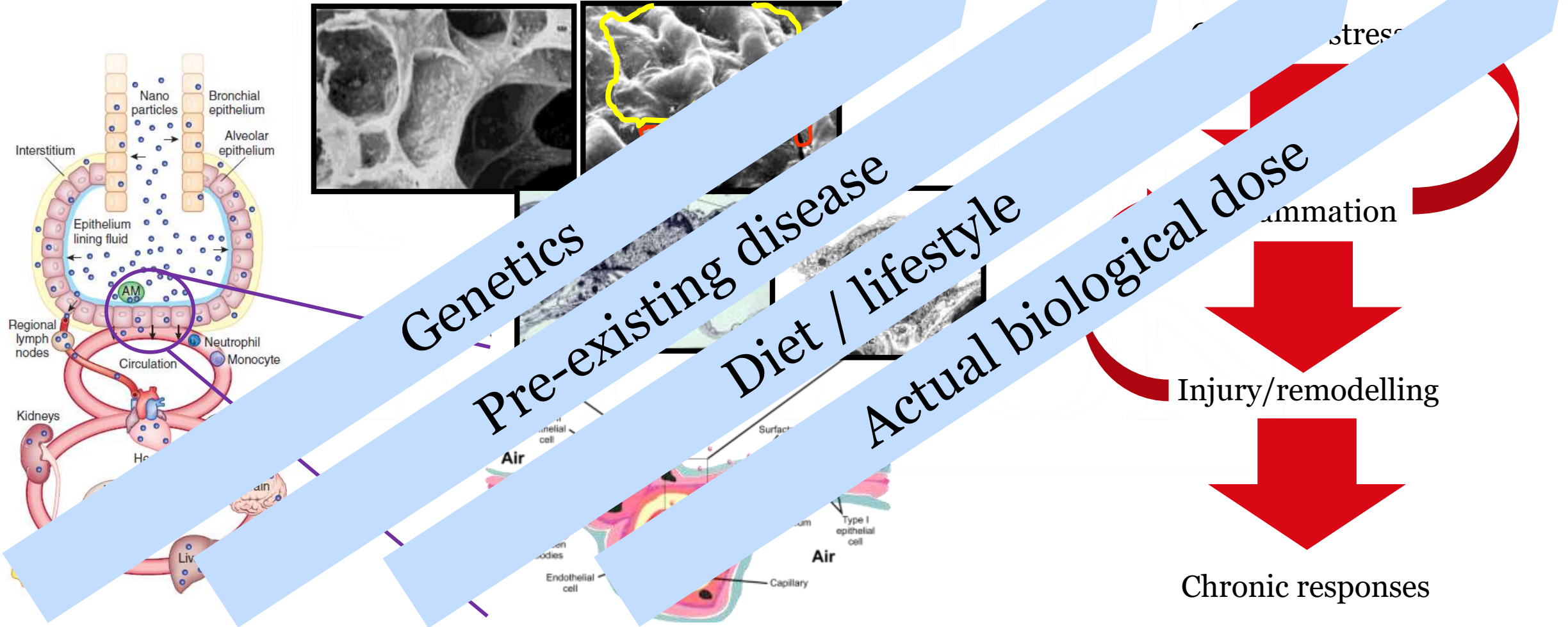
- 1000+ studies, reviews (e.g. ESCAPE (2013); ESCAPE HAAP (July 2013); HRAPIE (Dec 2013)
- HEI Ultrafines report (2013)
- WHO Black Carbon report (2012)
- IARC Diesel exhaust reports (2013/2014)
- WHO Burden of disease report (March 2014)
- Every Breathe we take (RCP – 2016)

If there's nothing more to add then there seems to be an awful lot of people publishing on it.....

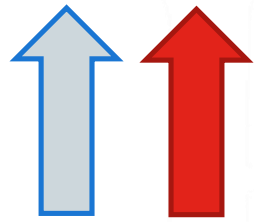
KEY Themes

- Multi-cohort analysis - ESCAPE
- **Contribution of PM_{2.5} to the global burden of disease**
- **Primary combustion derived pollutants - diesel**
- **Multi-pollutant models**
- Effects below the WHO guideline value
- **Impacts of PM_{2.5} exposures on the brain – from early life cognition to dementia**
- Indoor pollution – biomass
- **Alternative metrics – black carbon / PNC/ oxidative potential**
- Improved models / exposure estimates
- Prenatal impacts

How do pollutants interact with the airway?

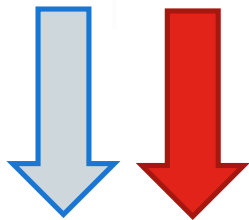


How to experimentally model the adverse effects of air pollutants?



Throughput

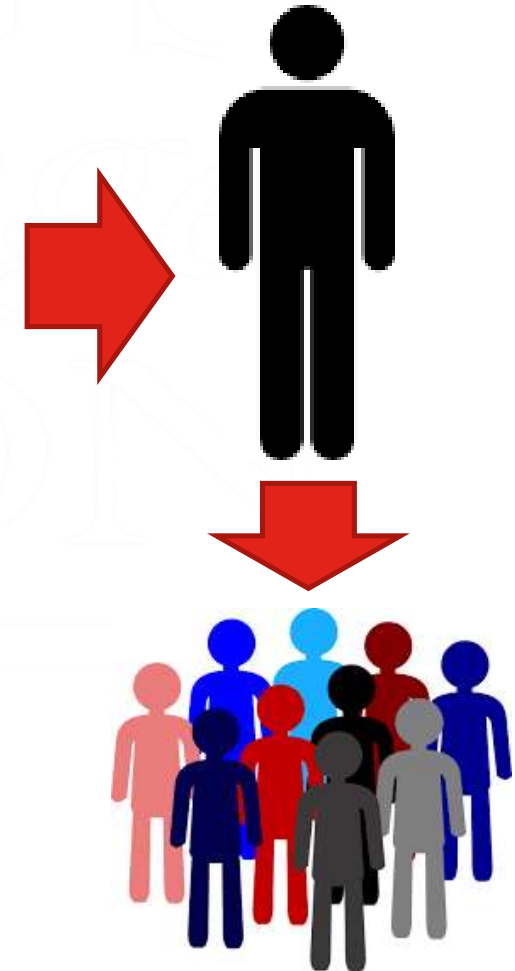
Coherence



- Immortalised cell lines
- Primary cells
- Commercial cell lines
- Differentiated primary cells
- Explants

- Co-culture
- Air-Liquid interface
- Submerged culture
- Respiratory tract lining fluid
- Interstitium
- Oxygen (13 vs. 21%)
- Tissue culture artefacts

In vitro – In vivo correlation



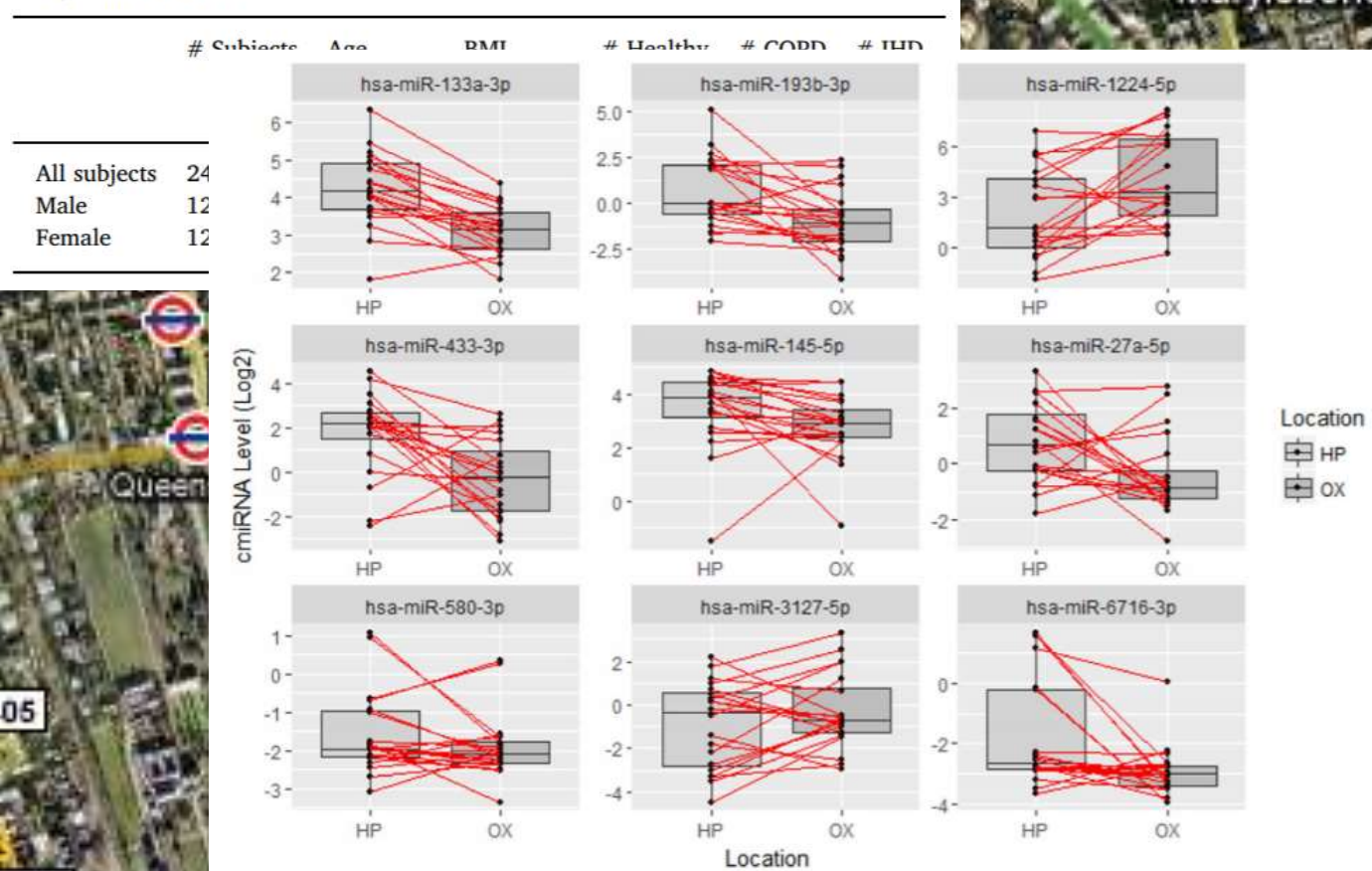
Challenges:

- Identifying the toxic components/characteristics of PM.
- Identifying source-specific toxicity.
- Disentangling the contribution of highly correlated pollutants to adverse cellular responses: PM_{2.5} and NO₂.
- Understanding the mechanisms leading to the systemic effects of air pollutants.
- Biomarkers of exposure
- Identifying/validating source specific epigenetic and metabolomics signatures in urban populations.
- Linking acute effects *in vitro* with long-term effects *in vivo*.

Emerging themes:

- ‘Omics to disaggregate the biological effects of different components of the ambient aerosol

Study population data.



Emerging themes:

- Accelerated ageing hypothesis

