A Comprehensive Assessment of Disparities in UK Air Pollutant Emissions, Exposure, and Health Burden to Inform Policy



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MOTIVATION Inequalities in air pollution are challenging to address because of inconsistencies in location and size of these based on the air pollutant and chosen attribute (emissions, concentrations or health burden). Here, we conduct a comprehensive evaluation of inequities to inform stakeholders to create targeted interventions and action plans.

APPROACH Here, we use UK NAEI for emissions, WRF-CMAQ models for concentrations and health-risk assessment models and demographic data for health burden estimation.



DISCUSSION NO₂ mortality burden rates highest for black population in SW; $PM_{2.5}$ for white population in EM/GL Black and Asian population experience the greatest disparities in emissions and concentrations, but the white population has the greatest disparities in mortality burden rates for most regions in England and Wales.

NEXT STEPS Extend analysis to Scotland and Northern Ireland. Examine inequalities at finer resolution than regions shown and also compare inequalities in urban versus rural landscape.

METHODS A) UK National Atmospheric Emissions Inventory (NAEI)

B) Modelling using the WRF-CMAQ setup over Europe and UK

Gridded annual emissions of $\rm PM_{2.5}$ and $\rm NO_x$ for 2019 are from the UK NAEI



NAEI annual totals are converted to hourly fluxes using the comprehensive emissions inventory toolkit EMIT Weather Research and Forecasting (WRF) for meteorology and Community Multiscale Air Quality (CMAQ) for atmospheric composition



Model output validated against observations from UK Met Office and Department for Environment, Food and Rural Affairs (Defra)

C) Health burden estimation and inequality analyses

We use an updated health impact function to estimate relative risk (RR) of premature mortality linked to $PM_{2.5}$ exposure (Marais et al., <u>https://doi.org/10.1029/2023GH000910</u>, 2023).

RR for NO₂-attributable mortality is from the UK Committee on the Medical Effects of Air Pollutants (COMEAP)

Population attributable fraction (PAF) = $1 - \frac{1}{RR}$

Premature mortality = $PAF \times BMR \times Population$





Metrics for inequality analyses:

- Population-weighted emissions and concentrations
- Population-normalised mortality rates
 These are estimated for the entire region
 and for individual ethnic groups in the UK

Feel free to reach out in case of any questions **k.vohra@bham.ac.uk**



QR code for more policy relevant research