Exploration of Health and Lungs in the Environment

Measuring the impacts of air pollution on East London school children

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Low Emission Zone Study

Example of a ‘natural experiment’ – change in pollutant exposure can be predicated and its effects monitored prospectively.

Objective: To quantify the impact of the Low Emission Zone (LEZ) on children’s health in East London.

Hypothesis: Reductions in exposure to traffic emissions will be associated with improvements in respiratory health in sequential yearly cross-sectional samples of 8-10 year-old children.
Projected benefits of the LEZ

**NO₂ difference plot – base case 2010**

Red lines indicate a 3 μg m⁻³ difference

**PM₁₀ difference plot – base case 2010**

Blue lines indicate a 0.75 μg m⁻³ difference

Study location
Postcodes in the Tower Hamlets area within 100 m of major road
## Studying the impact of the LEZ on children's respiratory health

### In an ideal world

<table>
<thead>
<tr>
<th>Within the intervention area</th>
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</thead>
<tbody>
<tr>
<td>Period pre-intervention → Period post-intervention</td>
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X-years before | X-years after

Thousands of children (matched for age, ethnicity, SES) followed longitudinally over the duration of the study
In the real world, or at least London

**Within the intervention area**

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**Outside the intervention area**

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X–years before

Thousands Hundreds of children (matched for age, ethnicity, SES) followed longitudinally cross sectionally over the duration of the study post implementation period, but able to capture effect attributed to the tightening of the scheme

X–years after
In the real world, or at least London

Within the intervention area

Period pre-intervention → Period post-intervention

Outside the intervention area

Period pre-intervention → Period post-intervention

X-years before X-years after

Thousands Hundreds of children (matched for age, ethnicity, SES) followed longitudinally cross sectionally over the duration of the study post implementation period, but able to capture effect attributed to the tightening of the scheme
What are you left with and how does this refine the question being asked?

Fraction of life in LEZ

Pre-phase 3

Post-phase 3
Examine effect of LEZ on:
- Respiratory health -
  - Spirometry, exhaled NO, respiratory symptoms
- Biomarkers of exposure
  - Urinary metals, carbon content of airway macrophages
- Susceptibility
  - Gene polymorphisms
- Response
  - Urinary 8-isoprostanes
  - Urinary 8-oxydG

Linkage at residential address level to estimated modelled exposures (NOx, NO₂, PM₁₀, PM₂.₅)
# Progress in assessments and analyses

<table>
<thead>
<tr>
<th>Year</th>
<th>Children</th>
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<tbody>
<tr>
<td>Year 1: 2008/9</td>
<td>202 children</td>
</tr>
<tr>
<td>Year 2: 2009/10</td>
<td>452 children</td>
</tr>
<tr>
<td>Year 3: 2010/11</td>
<td>460 children</td>
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<tr>
<td>Year 4: 2011/12</td>
<td>444 children</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data</th>
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<tbody>
<tr>
<td>Air quality modelled</td>
<td>years 1,2,3</td>
</tr>
<tr>
<td>Lung function</td>
<td>years 1,2,3</td>
</tr>
<tr>
<td>FeNO</td>
<td>years 1,2,3</td>
</tr>
<tr>
<td>Urinary isoprostanes</td>
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<td>Urinary metals</td>
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<tr>
<td>Urinary 8-oxo-2'-deoxyguanosine</td>
<td>years 1,2,3</td>
</tr>
<tr>
<td>Genotyping</td>
<td>years 1,2,3</td>
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</tbody>
</table>
Estimating exposures

Models

Annual means: NOx, NO₂, PM₁₀, PM₂.₅
- By residential address
- Weighted for time spent at home and school
- Varying buffer zones: 50, 100 and 200m
- Model updated to include resuspension

Measurements

Acute exposures: NOx, NO₂, PM₁₀, PM₂.₅
- London background
- PM components – toxicological parameters
- NOWCAST time resolved estimates
Nowcast to predict acute and sub-chronic exposures

Estimated current PM10 air pollution index levels, based on measurements taken up to 08:00 on Wednesday 8th December.

Estimated current NO2 air pollution index levels, based on measurements taken up to 08:00 on Wednesday 8th December.
Distribution of pupils chronic and acute NOx exposures
Then add in few unpredictable events.
Revisions

Pre-phase 3

Post-phase 3

Fraction of life in LEZ

LEZ-phase 1

LEZ-phase 2

LEZ-phase 3
Routes covered 2011 - 2012

Frequency

By pollutant concentration

Route Walked
- 1x
- 2x
- 3x
- 4x
- 5 or more times

Ultra Fine Particle Levels
- < 25 000 /cm³
- 25 000 - 50 000 /cm³
- 50 000 - 75 000 /cm³
- 75 000 - 100 000 /cm³
- > 100 000 /cm³
Urinary metals: Fuel combustion
Conclusions

1. Improvements in vehicle fleet, but limited improvements in air quality
2. Successful engagement of schools and children, over 4-years
3. High quality lung function and other outcome data
4. Successful modelling of pollutant exposures for each child. Novel use of acute exposure data
5. Demonstration of reduced FVC with increased exposure to traffic derived pollutants
6. Successful genotyping, for subsequent analysis of sensitivity
7. Examination of personal exposure to primary traffic pollutants
8. Examination of the biological dose of BC and metals
Contributions

LEZ study team
Centre for Primary Care and Public Health, QMUL: Chris Griffiths, Jonathan Grigg, Robert Walton, Isobel Dundas, Stephen Bremner, Neeru Garg, Alex Nanzer, Yasmeen Hanifa, Harpal Kalsi, Tom Round, Grace Tuaf-Toro, Peter Bridge, Ratna Sohanpal, Adam Briggs, Jonathan Grigg, Dev Ghadvi, Grace Tuaf Toro, Peter Timms, Louise Cross, Niki Jakeways, Seif Shaheen

MRC Centre in Allergic Mechanisms of Asthma, KCL: Tak Lee, Alex Faith

MRC-HPA Centre for Environment and Health:, KCL: Frank Kelly, Ian Mudway, Helen Wood, Jeenath Jamaluddin, Andy Grieve, Esme Purdie, Eleanor Smith

City University London: Les Mayhew. Gill Harper

University of Edinburgh: Aziz Sheikh

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